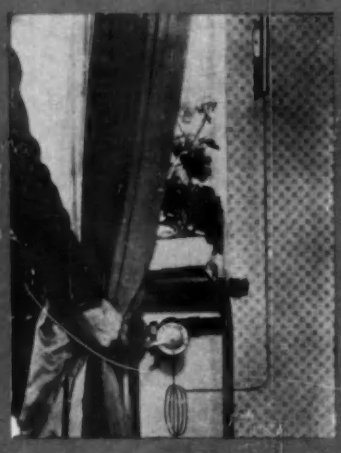
ENGINEERING AND
BOILER HOUSE REVIEW
ESTABLISHED 1899 SIXPENCE

VOL. 73 NO. 7 • THE PIONEER STEAM JOURNAL • JULY, 1958

Now also for low pressure steam plants!

Normal design with fixed phial.



Special design with capillary tube and loose phial, which can be used where the natural air circulation is checked.

Special design for covered radiators.

SAVE FUEL

A simple and lasting solution. It is a question of getting the fuel to go as far as possible.

Do it with

Danfoss **thermostatic radiator valve**

- Great sensitivity
- Economical operation of the plant
- Easy operation
- No stuffing box
- Phial unit can be interchanged without draining of the system
- Will prevent freezing
- Temperature range between 37.4° F. and 77° F.

The Danfoss Thermostatic Radiator Valve is provided with an adjustable temperature scale and is constructed so that each radiator is regulated separately. It can be used for all central heating plants and gives a new feeling of comfort as well as a considerable saving of fuel.

With a Danfoss Thermostatic Radiator Valve you determine the temperature.

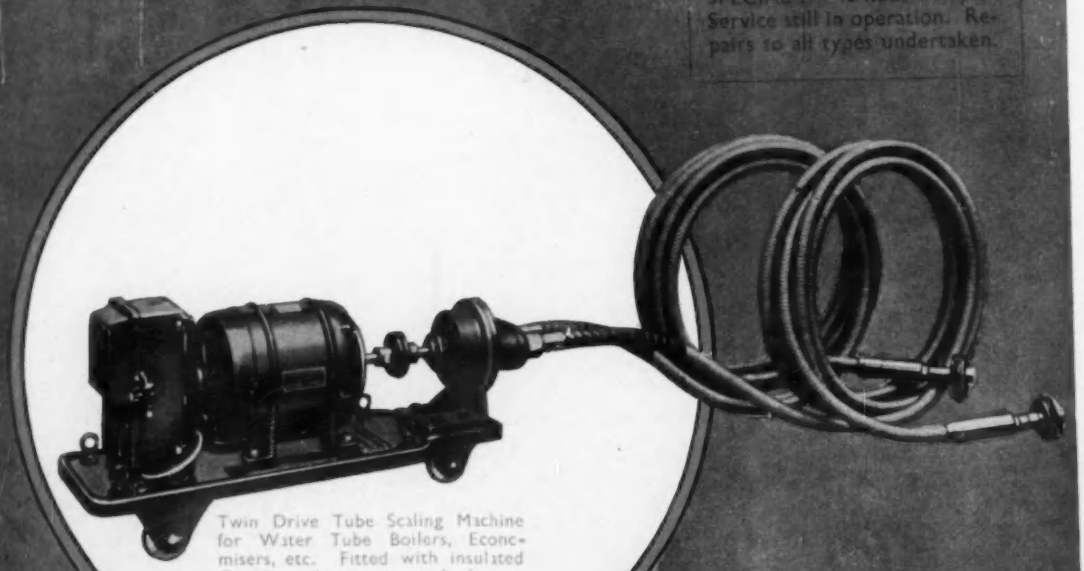
Write for the brochure Q 13-002 containing detailed information.

everything under Danfoss control

DANFOSS AUTOMATIC CONTROLS AND EQUIPMENT
13, Queensway, London, W.2. Telephone BAYswater 9321

Flexible Shafts *and* Flexible Shaft Driven Tools

SPECIAL: "48-hour" Repair Service still in operation. Repairs to all types undertaken.



Twin Drive Tube Scaling Machine for Water Tube Boilers, Economisers, etc. Fitted with insulated Coupling, Automatic push button control starter, Balanced and Enclosed Fly-wheel. Ball and Roller bearings throughout.

Grinding, Polishing, Buffing, Sanding, Tube Scaling and Tube Brushing Machines, etc., etc. Manufactured throughout in our own Works. As supplied to War Office, Air Ministry, Admiralty, all leading Railways, and Industrial Organisations in all parts of the world.

THE FLEXIBLE SHAFT MANUFACTURING CO.

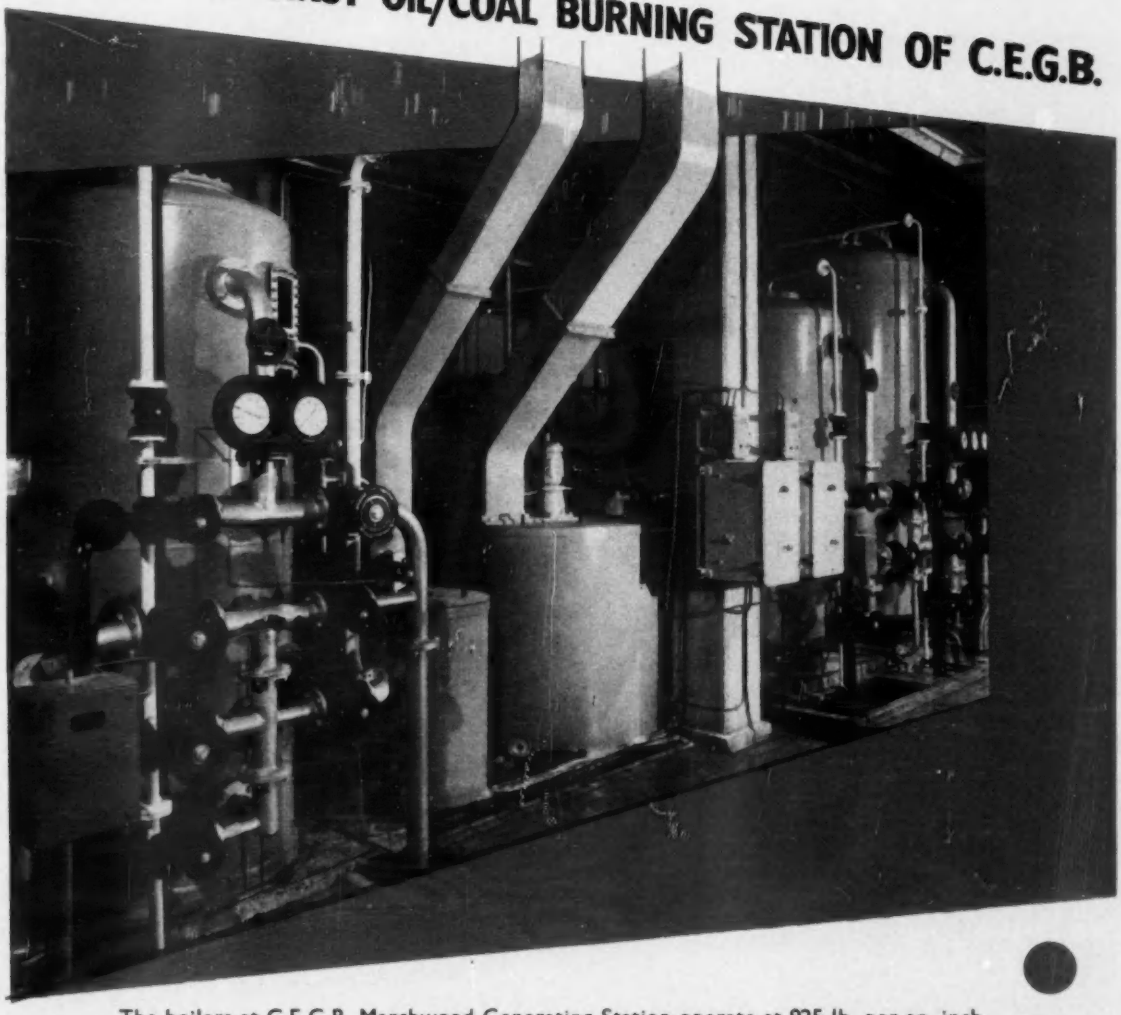
(Sole Proprietors: F.S. ENGINEERING LTD.)

TOWN ROAD · EDMONTON · LONDON · N · 9

Telephone: Edmonton 3541. Telegrams and Cables: Flexotrans Southtot London.

PERMUTIT

FOR FIRST OIL/COAL BURNING STATION OF C.E.G.B.



The boilers at C.E.G.B. Marchwood Generating Station operate at 925 lb. per sq. inch, and are provided with "Deminrolit" treated make up feed.

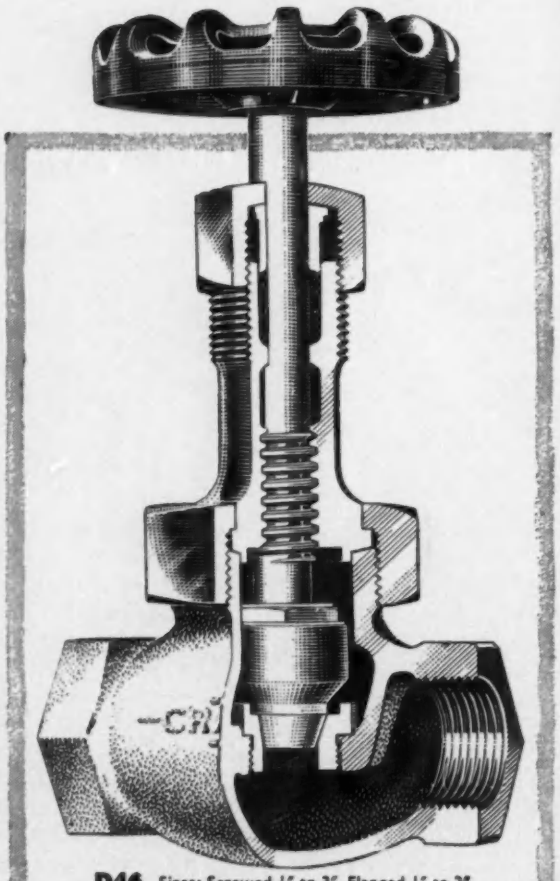
There is no split responsibility with a "Deminrolit" Plant because The Permutit Company design and manufacture the Plant, also develop and manufacture their own Ion Exchange Resins. This is exclusive to Permutit.

THE PERMUTIT COMPANY LIMITED

DEPT. T.H.317, PERMUTIT HOUSE, GUNNERSBURY AVENUE, LONDON, W.4 · TELEPHONE: CHISWICK 6431

A

FOR SEVERE SERVICE.



D46 Sizes: Screwed ¼" to 3". Flanged ½" to 3"

Screwed Hexagon ends with British Standard Taper Threads —or to American Standards. Flanged in accordance with British Standard Tables 'F' or 'H' diameters — or to American Standards.

Crane Bronze Check Valves D122 or D145 are recommended for use with these valves.

CRANE BRONZE GLOBE VALVES

with renewable Nickel Alloy Disc and stainless steel seat ring

This Globe Valve, designed for services under really rigorous conditions, is one of a series of Crane Bronze Valves—all of reliable and sturdy construction. The plug type nickel alloy disc and the stainless steel seat ring effect an extremely tight closure whilst allowing close regulation of flow when throttling. The two dissimilar metals were chosen after extensive metallurgical tests as offering the best resistance to corrosion and 'wire-drawing' or damage by foreign matter. Both disc and ring are moreover renewable and additional discs and rings can be supplied.

Valves with screwed ends are recommended for working pressures up to 250 pounds (steam 500°F); 500 pounds (water, oil or gas, cold, non-shock). They are manufactured from the usual Crane high grade materials like all Crane products, and are individually tested. Sizes 2" and smaller have a union bonnet—larger sizes a bolted bonnet, inside screw Both features make for ease of dismantling and reassembly after maintenance. Back-seating allows the valves to be repacked whilst fully open under pressure.

CRANE

VALVES OF BRONZE, CAST IRON AND CAST STEEL

CRANE LTD., 15-16 RED LION COURT, FLEET STREET, LONDON, E.C.4. Works: IPSWICH

Branches: Birmingham, Brentford, Bristol, Glasgow, London, Manchester V.7

KEEPING your hands off process steam operations which can be better done automatically is common sense, as far as it goes. Take Sarco automatic temperature controls into your thinking, and you can safely go the whole way.

You can, for example, have another look at your processing temperatures. All too often, these are unprofitably high. The product isn't necessarily better (often the reverse) and fuel is wasted.

But if the working temperature is reduced, is there any guarantee that it won't drop below the minimum? Sarco controls remove this doubt, this obstacle to a sound processing technique. Automatic and reliable, they let you get on with other things. Simple, self-acting and robust, they do the job with no fuss and little maintenance. They are not expensive to buy or install, because they don't need to be.

And it's quite a thought, that, if you *do* need a Sarco control, you're already paying for it. . . .

Spirax-Sarco Ltd

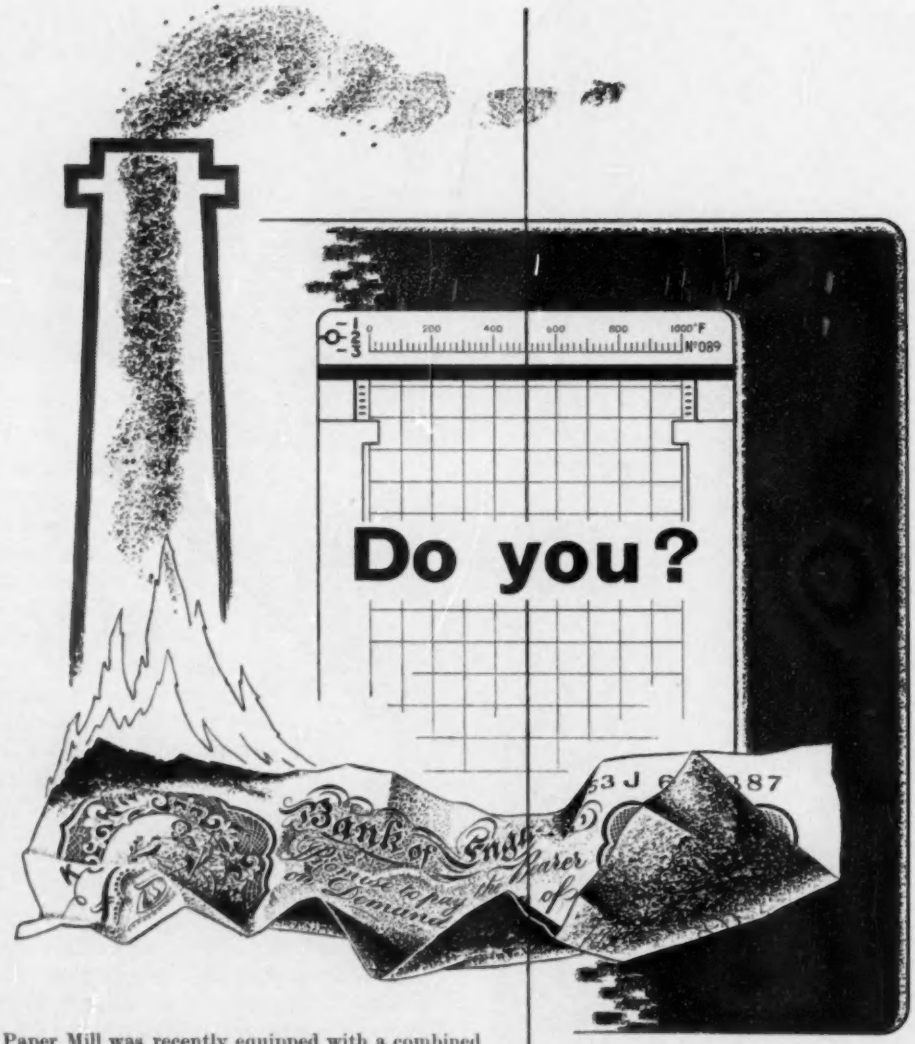
Please send full details and drawings for the simple, automatic temperature control of.....

NAME

ADDRESS

EB 759

Spirax-Sarco Ltd. Cheltenham, Glos. Phone: Cheltenham 5175-76 London: 28 Victoria Street, SW1 Abbey 6101-3832



A Paper Mill was recently equipped with a combined installation consisting of a N & Z multi-point Indicating Pyrometer, recorder and a plug selector switchbox for use on a battery of ten Lancashire Boilers. The installation discovered a heat loss of 13%. Within three months this figure had been reduced by 3.7%. Average weekly fuel consumption at the Mill is 500 tons of coal, and 3.7% of that represents an amount of money that no one could afford to burn.

For Boiler House instrumentation consult:-

NEGRETTI & ZAMBRA

Manufacturers of instruments for the indication, recording, controlling of: Temperature, pressure, liquid level, volume, specific gravity, humidity, etc.

NEGRETTI & ZAMBRA LTD · 122 REGENT STREET · W.1

STEAM COSTS

are often an UNKNOWN FACTOR

Our investigation may result in a considerable economy

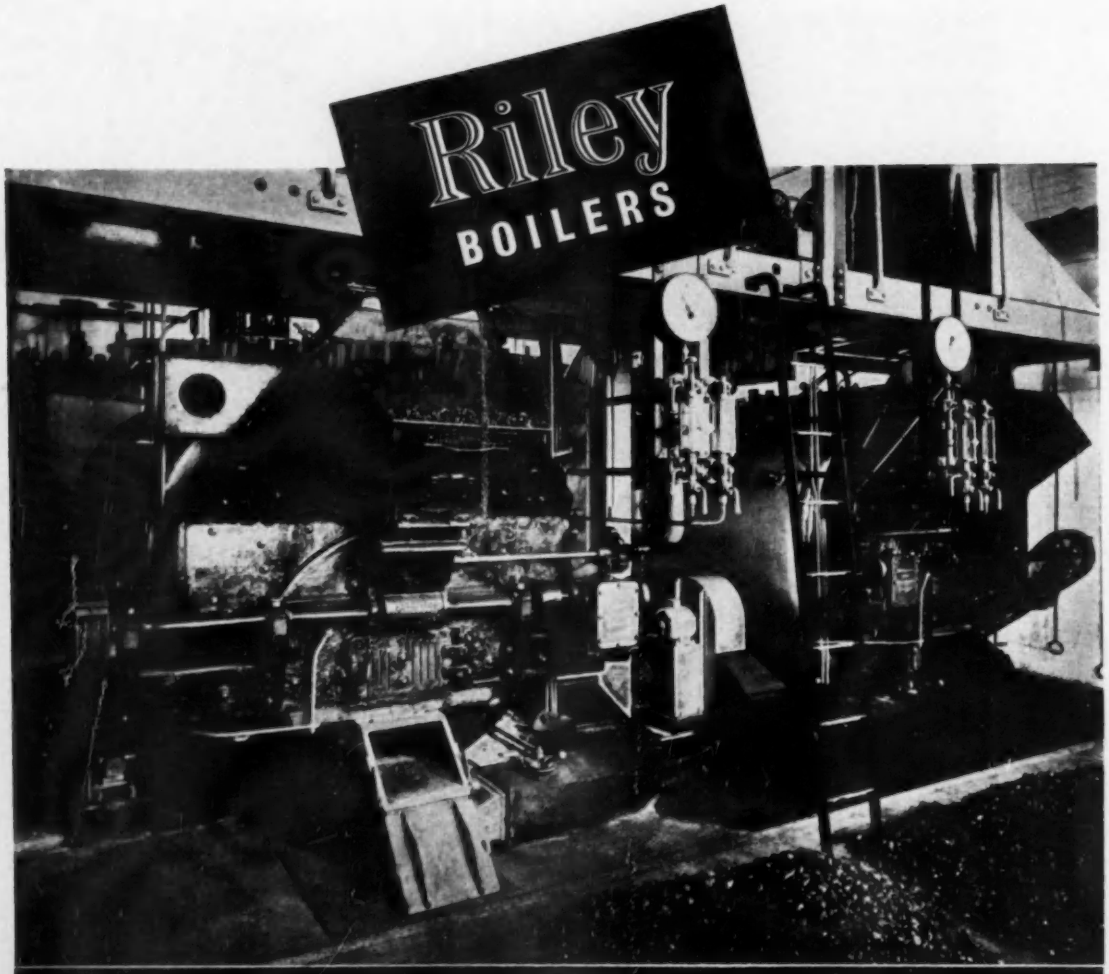
TURBINE

PATENT

FURNACES

INSTALLED UNDER GUARANTEE ENSURE EFFICIENT AND **SMOKELESS** COMBUSTION

THE TURBINE FURNACE COMPANY LIMITED
238b, GRAYS INN ROAD, LONDON, W.C.1



for ***Craftsmanship and Dependability***

Installation of ***FUEL SAVING ECONOMIC type BOILERS***

Manufactured by

STOCKTON CHEMICAL ENGINEERS & RILEY BOILERS LTD.

PERSEVERANCE WORKS, STOCKTON-ON-TEES

Tel: 67841 *Telegrams:* "Boiler" Stockton-on-Tees

Also makers of:-

VERTICAL LANCASHIRE, MARINE AND WASTE HEAT BOILERS,

STEEL CHIMNEYS, VESSELS AND TANKS

REAVELL ASKANIA REGULATORS

★

Combustion control for Boilers and Furnaces of all types, Pressure, Vacuum, Mixture and Temperature Regulators for Gases, Steam, Air, Liquids, for

Gas Works, Coke Ovens, Boiler Plant, Steel and Chemical Works, and Industrial Plants Generally

Write for particulars, mentioning this journal

REAVELL & Co. Ltd.
RANELAGH WORKS, IPSWICH

THE MUSGRAVE-NEU ROTARY DIFFUSER

(BRITISH PATENT 733533 AND 737833)

* *Low noise level*
* *High pressure*
* *High efficiency*

Represents the latest development in High Pressure Fan Design . . . Capable of pressures up to 3 lbs. per square inch in one stage, and higher in multi-stages . . . Surprisingly low noise level . . . Surge free at all duties . . . Many different pressure/volume characteristics are available to suit specific requirements. For full particulars regarding this amazing new Fan ask for our publication G.99. Available from any of our Branches or at Head Office.

MUSGRAVE AND CO. LTD

ST. ANN'S WORKS, BELFAST, NORTHERN IRELAND

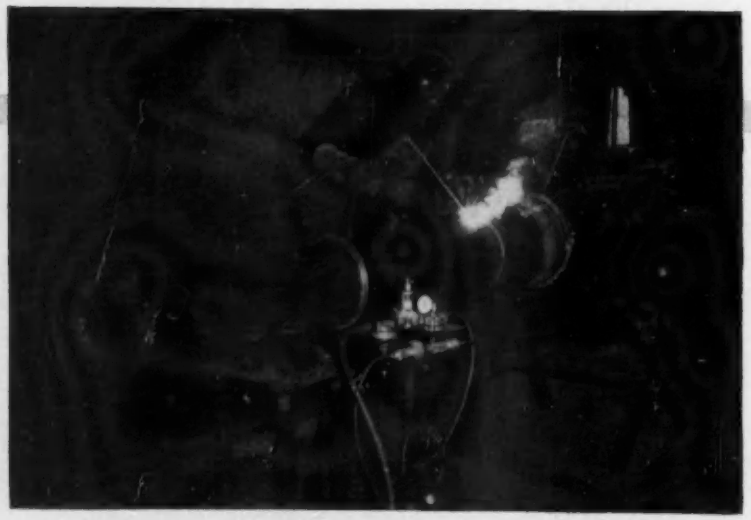
2 Howard St. Strand
LONDON WC2

34 Great North Road
NEWCASTLE-ON-TYNE 2

31 King Street, West
MANCHESTER 3

297 Hagley Road
BIRMINGHAM 16

41 St. Vincent Place
GLASGOW C1



WELDING CHARGE TUBES

The photograph shows an operator welding one of the 448 charge tubes, using low hydrogen electrodes throughout.

The Unit Superheater and Pipe Co. Ltd., following initial contracts for reactor charge tubes for Calder Hall and Chapelcross power stations, has been entrusted by Whessoe Limited, member company of the Nuclear Power Plant Co., to produce the charge/discharge and control rod stand tubes for Bradwell Power Station.

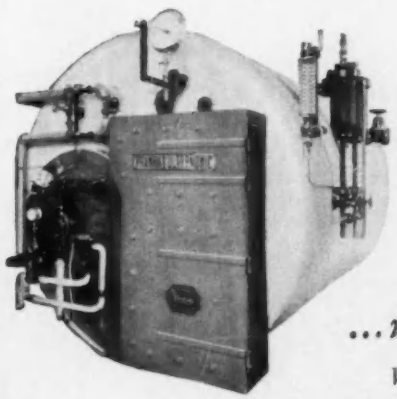
THE **UNIT** SUPERHEATER AND PIPE CO. LTD · UNIT WORKS
SWANSEA Telephone: Swansea 54091 (6 lines). Telegrams: 'Superunits', Swansea. Telex: 48-208.

UNIT

Two Paxman Double Pass 'Ultranomic' hot water heaters provide the heating for Eltham Green School, Middle Park, London, S.E.9.

Architect: J. L. Martin, M.A., Ph.D., F.R.I.B.A.
Architect to the L.C.C.
Heating Engineers: J. Rawlinson, C.B.E., M.Eng., M.I.C.E., M.I.Mech.E.
Chief Engineer to L.C.C.

... modern buildings need modern BOILERS!



Even perfectly designed buildings will fall short of expectations unless the efficiency of the installations are completely in keeping. Discriminating heating and ventilating engineers know that Paxman boilers are extremely reliable and economical—that's why they are always first choice.

Davey, Paxman & Co. Ltd. are aware that heating experts are always seeking higher standards of boiler efficiency, and are confident that not only can they meet these requirements in every respect —they can surpass them.

That is why . . .

... whatever your problem – Paxman have the answer!

Write for full details and fully illustrated literature to:

DAVEY, PAXMAN & CO. LTD.

COLCHESTER · ENGLAND

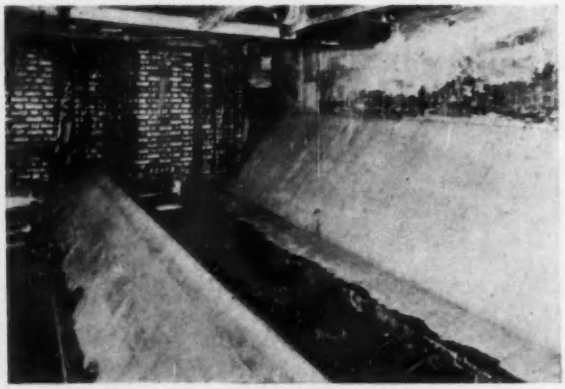
TELEPHONE: COLCHESTER 5151-6
TELEGRAMS · PAXMAN · COLCHESTER · TELEX 1875

ALSO MAKERS OF DIESEL ENGINES, ROTARY VACUUM FILTERS AND HEAVY FABRICATION WORK

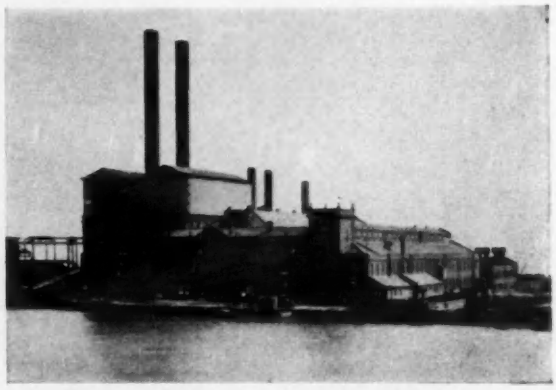
B62

CONCRETES & MORTARS MADE WITH CIMENT FONDU ARE EXTENSIVELY USED FOR ASH HOPPERS

* They become rock-hard and ready for full use the day after placing.
* Their great strength provides high resistance to the abrasion of ashes sliding down hoppers.
* They are highly resistant to attack by chemicals, such as sulphur-containing compounds present under moist conditions.
* When made with refractory aggregates they are resistant to high temperatures and extreme thermal shock.

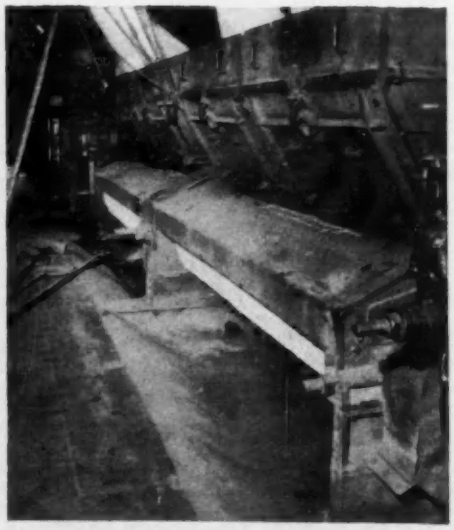


Clarence Dock Power Station. Hopper lined with ordinary Ciment Fondu concrete and the brickwork pointed with Ciment Fondu mortar.



Brighton 'A' Power Station. Ash pits and chimneys lined with ordinary Ciment Fondu concrete.

*Battersea Power Station. Ash Hopper Foundation of *Refractory Concrete designed to catch the hot burnt out ash falling from the boiler grate and wash it into the ash race. Overall size is 34' by 15' 6" by 4' 2".*



Acton Power Station. Hopper beneath chain grate stoker lined with ordinary Ciment Fondu concrete. Linings are 12' long by 2" and extend the full width of the grate.

***REFRACTORY CONCRETE**
the adaptable Refractory material made with crushed firebrick and CIMENT FONDU

CIMENT FONDU
Regd Trade Mark
ALUMINOUS CEMENT

The Cement for Industry

FOR SPEED · STRENGTH
RESISTANCE · REFRACTORINESS

Ciment Fondu is manufactured by

LAFARGE ALUMINOUS CEMENT COMPANY LIMITED

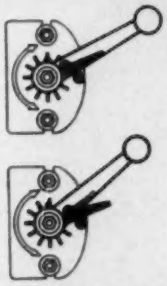
73, BROOK STREET, LONDON, W.1. Telephone: MAYFAIR 8546

You are invited to write for further details and photographic examples

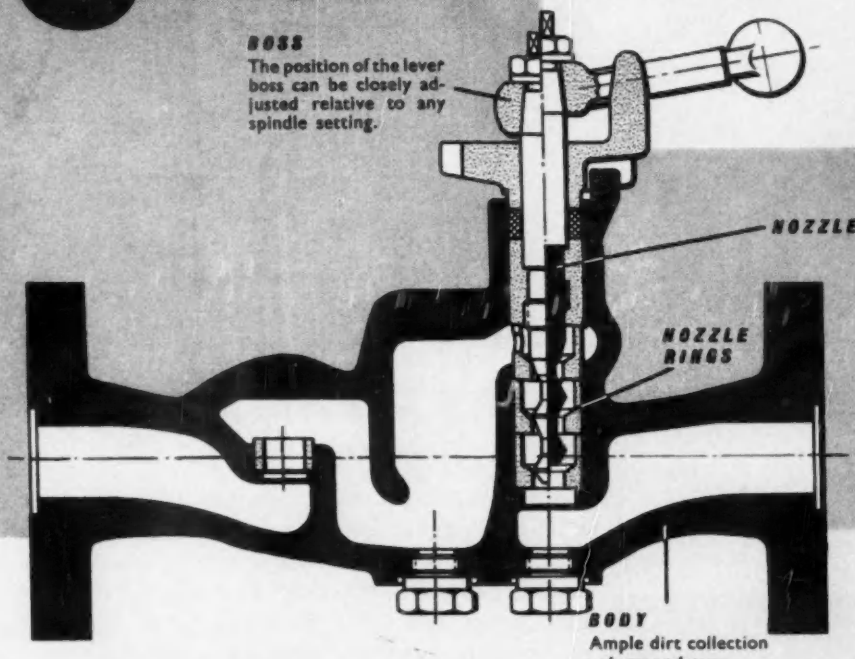
AP3-1305

GESTRA

CLEAR VISUAL SETTING
The indicator control lever is provided with an auxiliary indicator making it possible to see from a distance if the drain is set for "normal operation" or for "blow through."



BOSS
The position of the lever boss can be closely adjusted relative to any spindle setting.



BODY
Ample dirt collection volume and easy connection

SERIES 'WK'

Stage nozzle Steam Trap

Now, for the first time, GESTRA introduce an automatic condensate drain and blow-through device *with visual indication of nozzle setting*. This condensate drainage device with the famous GESTRA stage nozzle (which has been proved by over 100,000 applications) includes a precision turbulence-chamber of the highest thermodynamic efficiency. An illustrated brochure giving full design details and performance data is available free on request.

lv PRESSURE CONTROLLERS LIMITED *A Member of the Metropole Group of Companies*

ATLAS HOUSE, 683 LONDON ROAD, ISLEWORTH, MIDDX. TELEPHONE: ISLEWORTH 7273-4-5

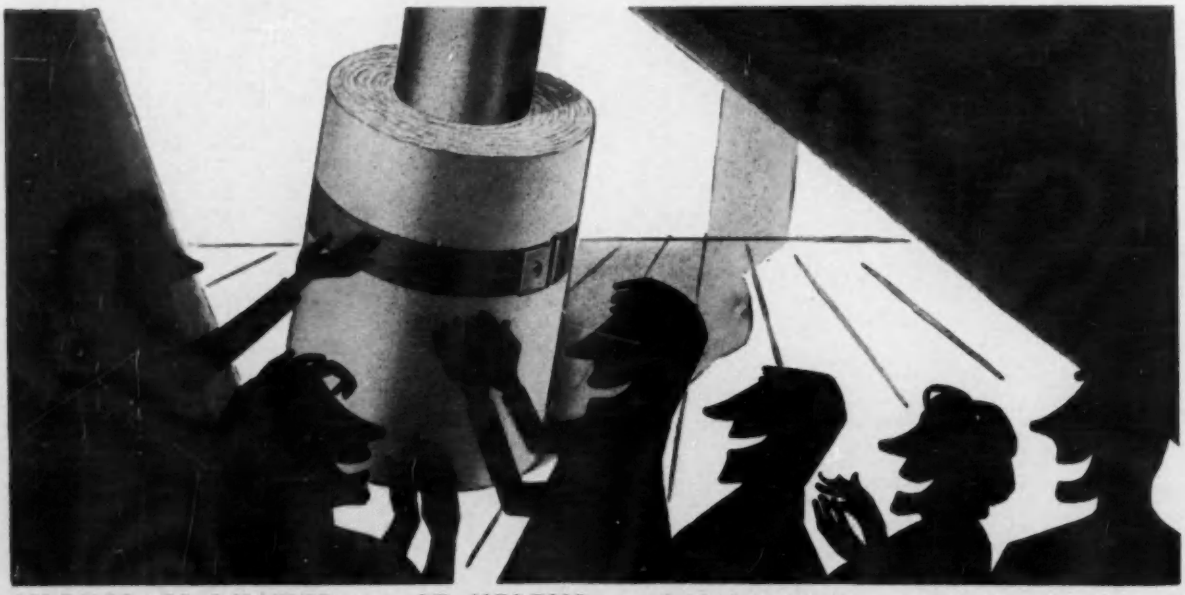
"I WAS THE VILLAIN"

—HOT WATER PIPE HISSES

"I work in a block of flats. It is my job to carry hot water up to baths and radiators. But they might have called me Luke for all the warmth I used to deliver! I lost most of it on the way! First there was Fred, the boilerman, he used to warm his feet on me; then Mrs. Fred the housekeeper, used to drape her smalls over me. And so I cooled as I climbed. But now that's all changed. I'm decently dressed and decently behaved. Rigid sections of Fibreglass hold me tight—from boiler to tap. Now it's hot radiators and boiling baths for everyone, everywhere. All my own work—with Fibreglass of course!"

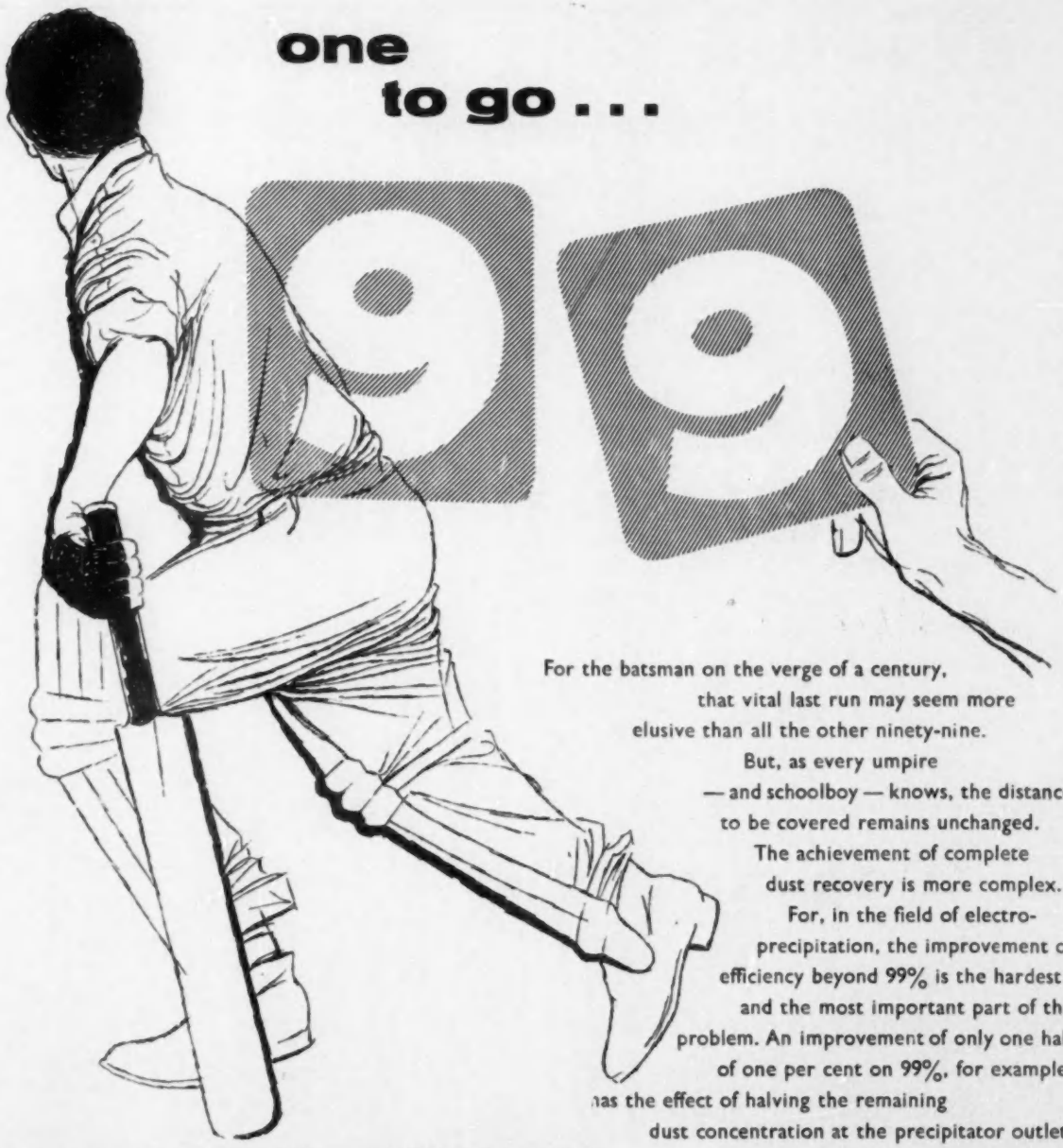
FIBREGLASS
TRADE MARK

"Rigid Sections saved my honour" *—HOT WATER PIPE REVEALS*



FIBREGLASS LIMITED · ST. HELENS · LANCASHIRE · ST. HELENS 4224

one to go . . .



For the batsman on the verge of a century, that vital last run may seem more elusive than all the other ninety-nine. But, as every umpire — and schoolboy — knows, the distance to be covered remains unchanged. The achievement of complete dust recovery is more complex. For, in the field of electro-precipitation, the improvement of efficiency beyond 99% is the hardest and the most important part of the problem. An improvement of only one half of one per cent on 99%, for example, has the effect of halving the remaining dust concentration at the precipitator outlet.

%	HUNCOAT POWER STATION NO. 1 UNIT	CHADDERTON 'B' POWER STATION NO. 2 UNIT	FLEETWOOD POWER STATION NO. 3 UNIT
ACTUAL EFFICIENCY (AT M.C.R.)	99·43	99·44	99·73*
GUARANTEED EFFICIENCY (AT M.C.R.)	98·00	98·00	97·5

* Subject to confirmation

Electro-precipitators designed and built by Simon-Carves Ltd achieved the efficiencies shown under stringent official acceptance test conditions at maximum continuous rating. The tests were observed by representatives of the Central Electricity Generating Board.

HIGH EFFICIENCY ELECTRO-PRECIPITATION BY **Simon-Carves Ltd**

STOCKPORT, ENGLAND

OVERSEAS COMPANIES | *Simon-Carves (Africa) (Pty) Ltd: Johannesburg* *Simon-Carves (Australia) Pty Ltd: Botany, N.S.W.*

SC 195/PS

EVERSHED

Leaders in

INSTRUMENTATION

and ELECTRONIC

PROCESS CONTROL

EVERSHED PRODUCED

The **first** full scale application of Electronic Process Control to an Oil Refining Plant.

The **first** British fully automatic Electronic Control and Instrumentation scheme to be fitted to any boiler.

The **first** closed loop Electronic Process Control Installation applied to the process of extracting sugar from sugar-beet.

The **first** automatic electronic control installation supplied for a Bessemer Converter plant.

The industries mentioned are but a few of the many which use this system of electronic control. The flexibility and inherent simplicity of the EVERSHED control system makes it ideally suitable for any industry where processing is involved.

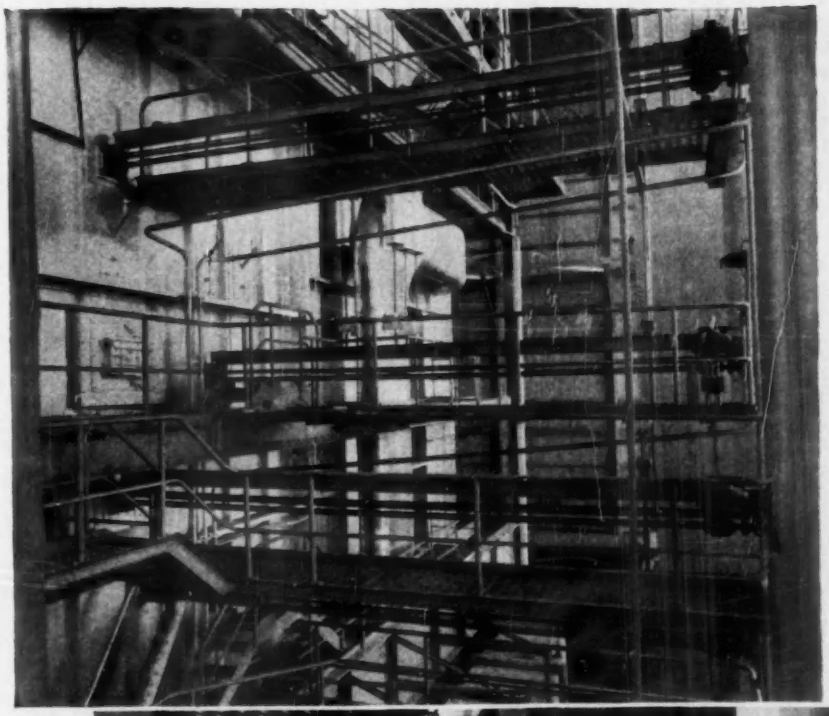
EVERSHED & VIGNOLES LIMITED • CHISWICK • LONDON W.4

EVERSHED & VIGNOLES (CANADA) LIMITED • TORONTO • CANADA

EVERSHED ENRAF • DELFT • HOLLAND

7/68

HOPKINSONS' SOOT BLOWERS
at a Continental Power Station



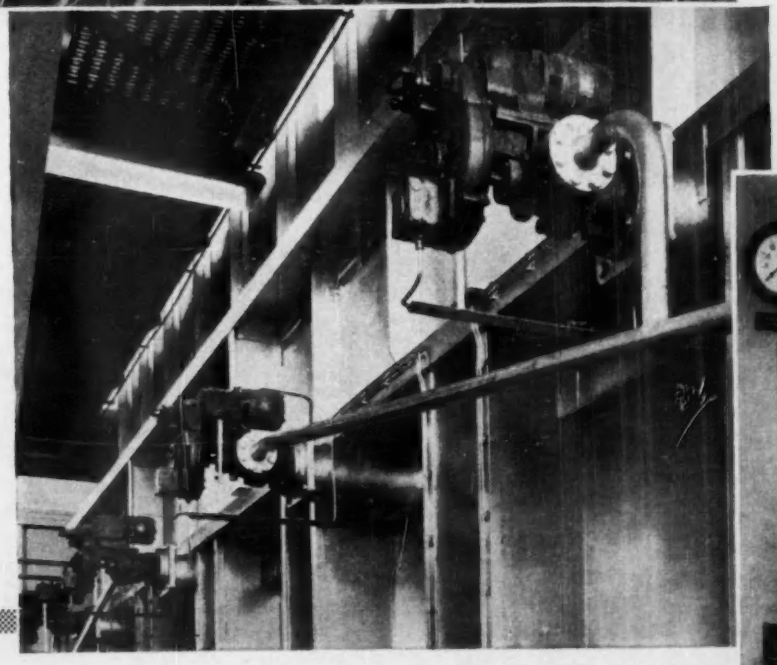
Long Retracting Blowers, sequence-controlled

The photographs show our soot blowing equipment installed at a notable power station in Holland.

Our sequence-controlled blowers give continuity in operation, accuracy of control and characteristic 'Hopkinson' reliability in performance.

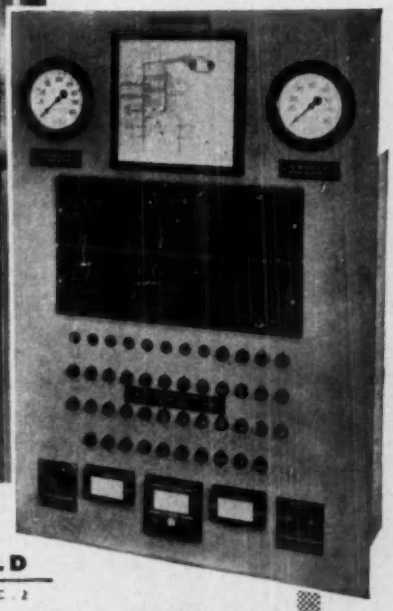
A complete range of equipment is available for every type of water-tube boiler installation.

Photographs by courtesy of Provinciaal Noord-Brabantsche Electriciteits Maatschappij



Rotary Soot Blowers

Soot Blower Cubicle



HOPKINSONS LIMITED · HUDDERSFIELD

LONDON OFFICE: 34 NORFOLK STREET · STRAND W.C.2

HV 109

Charming little creatures,
aren't they?
Tough too — just like
their Dad.

But dash it all — we're supposed to be hunting *big* game.

Not this week, old chap.
Mustn't give people the
impression we're big stuff
and nothing else . . .
Mind your fingers —
the vicious brutes!

Chesterfield Tubes

THE BIG GAME OF THE TI GROUP

Chesterfield are famous for big steel tubes, but we're game for any size you want. The examples illustrated are seamless steel carbon dioxide and oxygen cylinders for fire extinguishers and medical services equipment. The smaller of the two is only 3½ ins. long.

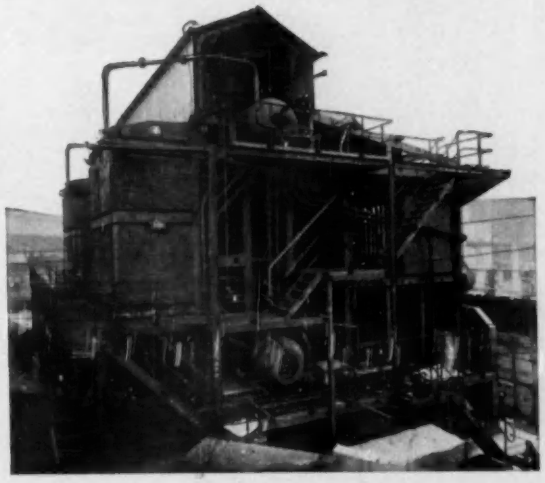
THE CHESTERFIELD TUBE COMPANY LIMITED · CHESTERFIELD · ENGLAND

CRC 53

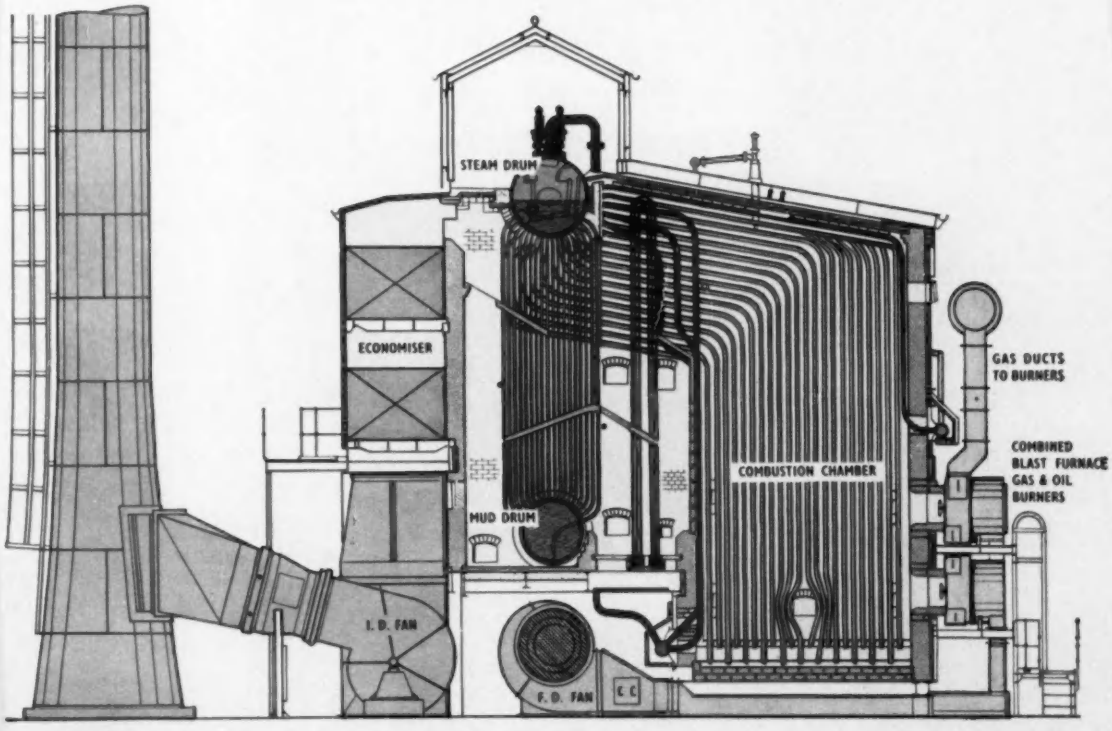
JOHN THOMPSON 'INTEGRAL'

WATER TUBE BOILERS

The John Thompson 'Integral' boiler is basically a two drum water tube unit which can be supplied for solid, liquid or gas firing. Water walls are used and these reduce brickwork maintenance and cut radiation losses, whilst providing flexibility and rapid response to increased steam demands. The combustion chamber design is such that low heat release rates are attained with relatively small furnace areas. Particular care has been given to circulation and a system of internal baffles is arranged to give high steam purity. Adequate water storage capacity is ensured by the large single bank of tubes and its associated downcomers together with the water walls and their independent feeding circuits. The installation at Stewarts and Lloyds consists of two John Thompson 'Integral' boilers each with an M.C.R. of 50,000 lb./hr. on blast furnace gas or 75,000 lb./hr. on oil firing. The working pressure is 450 lb./sq. in., and final steam temperature 750°F. Steam generated is used for turbo-alternators and turbo-blowers and extraction steam for works processes and space heating. John Thompson have long experience in manufacturing all types of boiler plant and are able to advise on the most suitable equipment for specific requirements.



Below is shown the arrangement of a John Thompson 'Integral' boiler fired by blast furnace gas or oil at Messrs. Stewarts and Lloyds, Bilston. Above, one of the boilers is seen during erection.

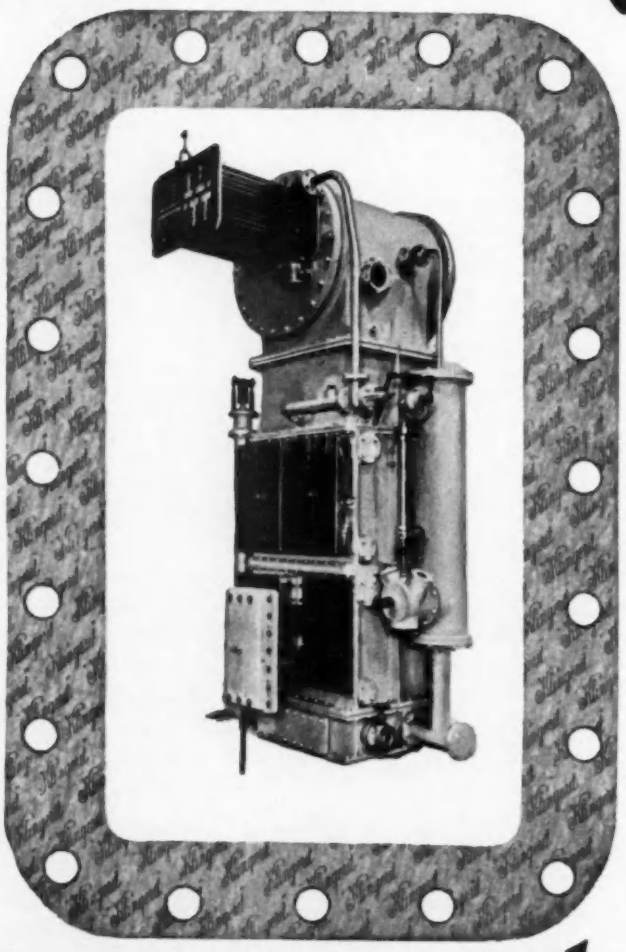


JOHN THOMPSON GROUP

JOHN THOMPSON WATER TUBE BOILERS LIMITED · WOLVERHAMPTON

WTB/4

Cut out for the job!



"Klingerit" joints used on the Preheater Condenser tubeplates in an Aiton 20 Tons per day Marine Type Evaporator Distiller. (Photograph by kind permission of Messrs. Aiton & Co. Ltd., Derby.)

Klingerit JOINTINGS

RICHARD KLINGER LIMITED, KLINGERIT WORKS, SIDCUP, KENT. *Telephone: Foots Cray 7777*

G26/58/3

Thorpe Marsh Power Station

THE BOILER BEING SUPPLIED BY INTERNATIONAL COMBUSTION LIMITED TO THE CENTRAL ELECTRICITY GENERATING BOARD FOR THE PROJECTED THORPE MARSH POWER STATION WILL HAVE HOWDEN AIR PREHEATERS, DRAUGHT PLANT AND MECHANICAL DUST COLLECTORS.

The four Howden air preheaters, with a total heating surface of 1,208,000 sq. ft. will be the largest regenerative air preheaters ever built. The four Howden forced-draught and four Howden induced-draught fans will handle a total of 3,150,000 cubic feet of air and gas per minute.

HOWDEN

JAMES HOWDEN & COMPANY LIMITED

195 SCOTLAND STREET, GLASGOW, C.5 and 15 GROSVENOR PLACE, LONDON, S.W.1

Specialists in the design and manufacture of equipment for

MOVING OR COMPRESSING AIR AND GASES

TRANSFERRING HEAT FROM ONE FLUID TO ANOTHER

CLEANING AIR AND GASES

He would have the hump if you mentioned it

But someone should have told him. Corrosion in boilers and steam-raising plant should be a thing of the past—but still there are those who do not Apexiorise. For over 50 years leading boiler manufacturers have specified "Apexior Number 1"—the *economical* safeguard against corrosion, where wet temperatures of 175° to 1000°F. are met. *Certain* protection for at least 12 months is assured with a double coat of "Apexior Number 1". After the initial treatment only one coat is necessary. Scale too provides no danger as it does not adhere firmly to Apexiorised surfaces; there is less of it and it is more easily removed.

In certain industries it is a most important advantage of "Apexior" that it does not affect water by taste, taint or smell. Make sure that you know all about "Apexior" and send for your copy of the "Apexior Manual".

DAMPNEY'S APEXIOR REGISTERED

BRITISH PAINTS LIMITED

APEXIOR DIVISION

PORTLAND ROAD, NEWCASTLE UPON TYNE, 2.
CREWE HOUSE, CURZON STREET, LONDON, W.1.

SYDNEY · ADELAIDE · TORONTO · DURBAN · CAPE TOWN
CALCUTTA · TRINIDAD · NEW YORK · ARKLOW

Our world-wide service is at your disposal for the asking

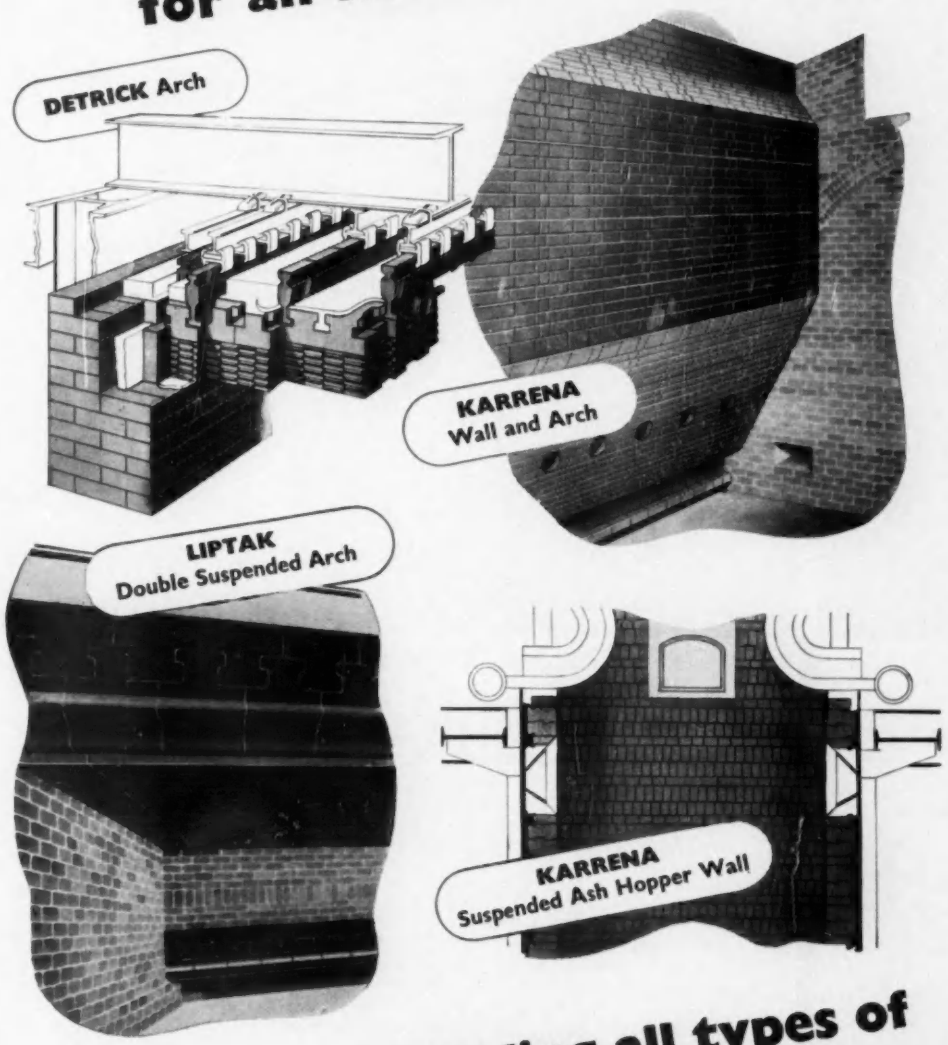
"APEXIOR NUMBER 1" PREVENTS CORROSION IN STEAM-RAISING PLANT

But for cold-wet surfaces up to 125°F.—use "APEXIOR NUMBER 3"

BPL/A38

GLENBOIG FIREBRICKS

for all Industrial Purposes...

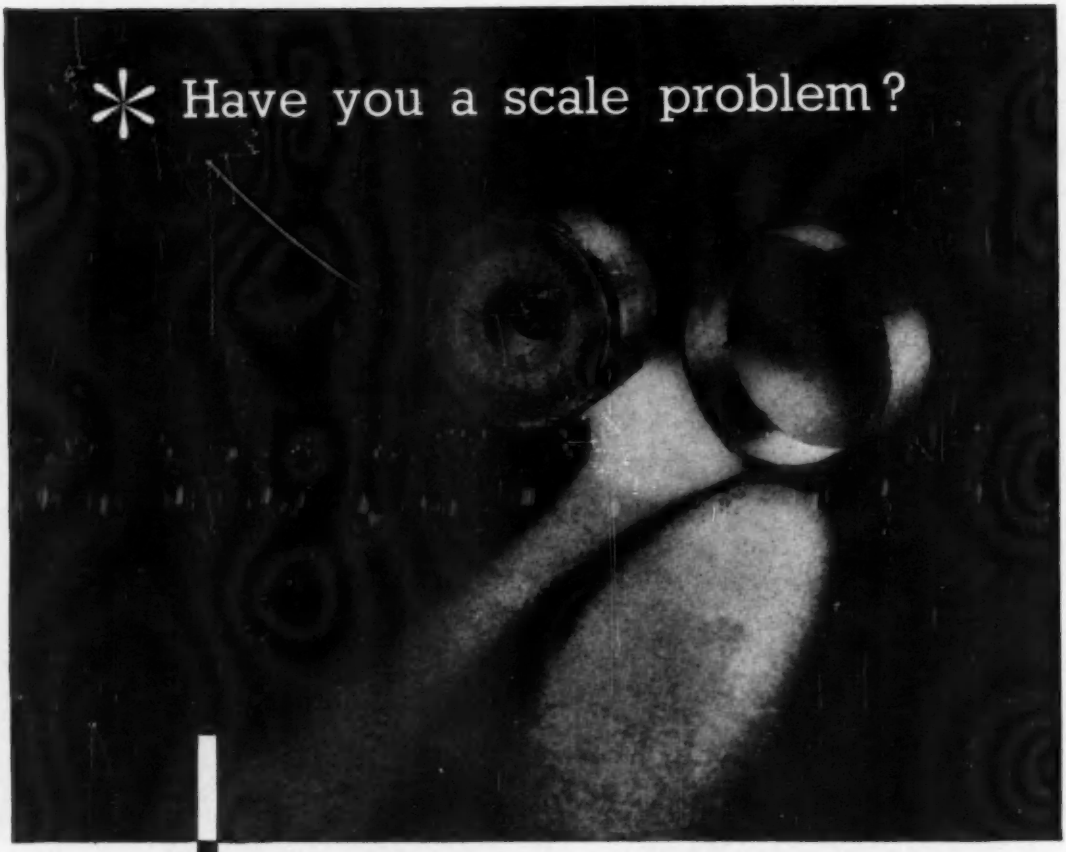


...including all types of SUSPENDED WALLS and ARCHES

THE GLENBOIG UNION FIRE CLAY CO LTD · GLENBOIG · LANARKSHIRE · SCOTLAND
Export Agents GENERAL REFRACTORIES LTD · GENEFAX HOUSE · SHEFFIELD 10

C

* Have you a scale problem?



This dramatic illustration, an actual photograph of two pieces of copper piping cut from the same length, shows, on the left, how scale deposit restricts flow and consequent heat transfer and, on the right, how Starit treatment removes the obstructing matter, leaving the surface of the pipe unimpaired.

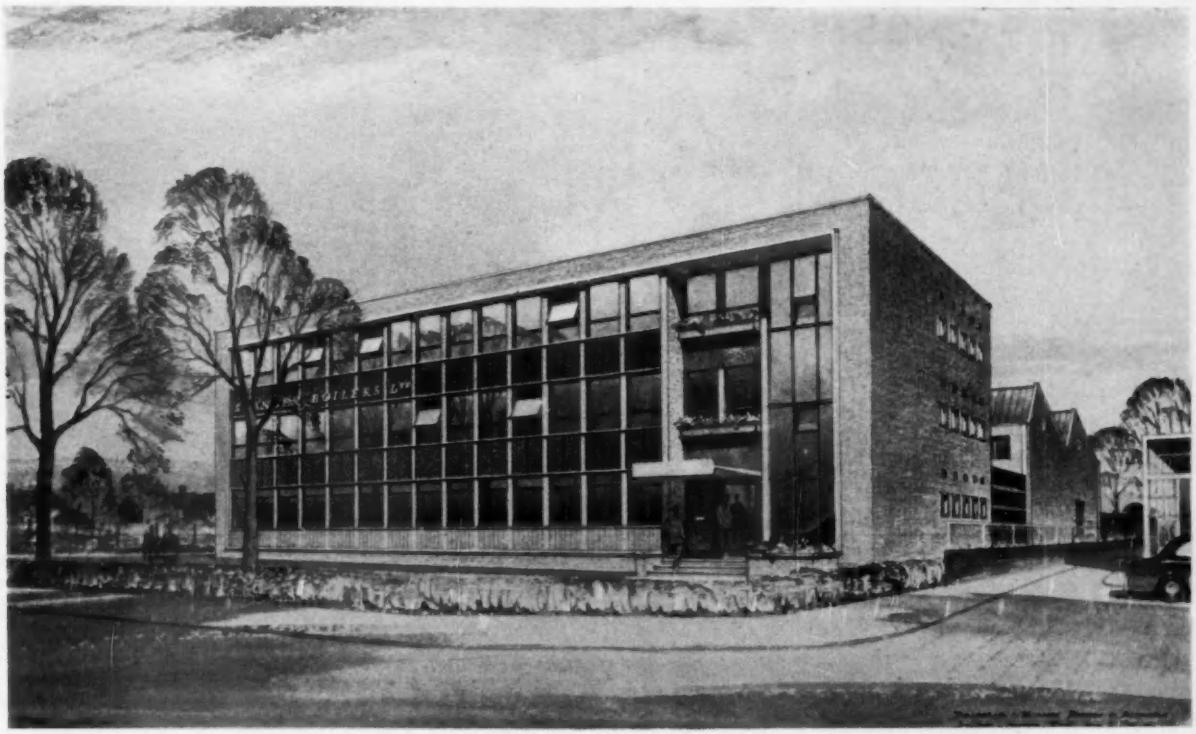
Scale deposits impose stresses in the metal and seriously reduce the heat transfer efficiency so vital for economical steam raising. Starit solution effectively removes most types of scale from boilers, feed pipes, heat exchangers, cooling systems and similar apparatus, cleaning those awkward corners beyond manual reach and leaving the metal in a first-class conducting state. The unique formulation of Starit ensures rapid attack on the scale whilst its action on the boiler plate is inhibited.

As there are certain rare cases where the scale is not susceptible to chemical attack, we invite you to send us a sample of scale, so that we can determine whether Starit should be used. We will also supply on request a booklet dealing with the application and limitation of Starit and the methods of using it.

STARIT TRADE MARK

STARIT **STARIT LIMITED**
DARWEN · LANCS

54



Progress

IN BOILER DESIGN AND MANUFACTURE

In just over twenty years, we have gained a world-wide reputation for first-class design, workmanship and high performance. The demand for our boilers, all of which incorporate the patent SWIRLYFLO tube, has increased rapidly during these years. To meet this increase and to maintain the high quality service given in the past, we have built new premises at Bracknell, Berkshire. In future all enquiries and correspondence should be sent to us at the new address given below:

Swirlyflo Tubes

SPANNER BOILERS LIMITED

WOKINGHAM ROAD · BRACKNELL · BERKSHIRE

Telephone: Bracknell 1500 · Telegrams: Swirlyflo, Bracknell, Telex · Telex: 84130

tailor-made to each job!

MULTIRAIL fabricated steel handrail standards have proved to be as rigid as the solid forged type, with the advantages of four ferrules enabling vacant ferrules to be used in carrying power lines, air and gas pipes, etc.

MULTIRAIL fabricated steel handrail standards

"SAFETREAD" FLOORING IS

welded for extra strength

Tailor-made and not just cut to fit, 'Safetread' flooring is no dearer to specify than ordinary steel flooring, but provides maximum strength with minimum of materials; non-skid surface; 82% light and air penetration; a neat-fitting, clean appearance.

SAFETREAD WELDED FLOORING

Write for detailed literature to:

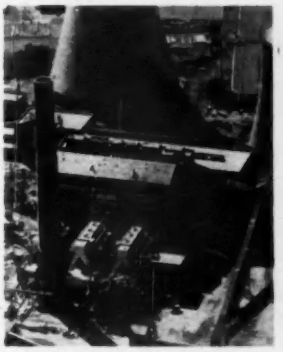
Allan Kennedy & CO. LTD

MARITIME STREET · STOCKTON-ON-TEES

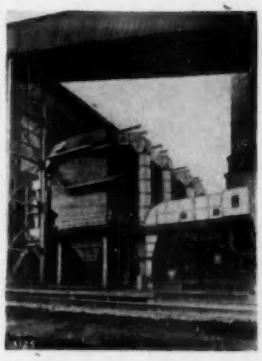
Tel: Stockton 65464 (4 lines). Grams: Grating, Stockton-on-Tees. Also at 207 Victoria Street, London, S.W.1

CLEAN AIR with STURTEVANT PLANT

STURTEVANT

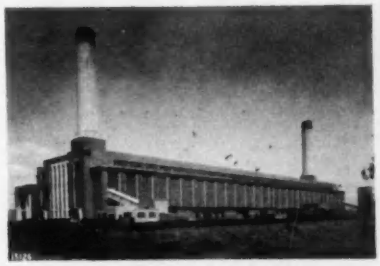


Salisbury Power Station, Rhodesia, is equipped with Sturtevant Precipitators

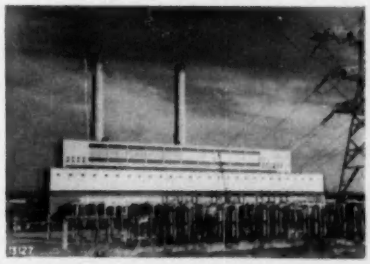


Sturtevant Precipitators installed on the boiler plant of a large chemical works.

ELECTROSTATIC PRECIPITATORS



Uskmouth "A" Generating Station where 12 Sturtevant Precipitators are installed.



Castle Donington Generating Station where Sturtevant Precipitators are operating.

FOR POWER STATIONS

Hundreds of Sturtevant Precipitators are in operation in central power stations and industrial boiler plants. They are the most efficient apparatus for cleaning flue gases.

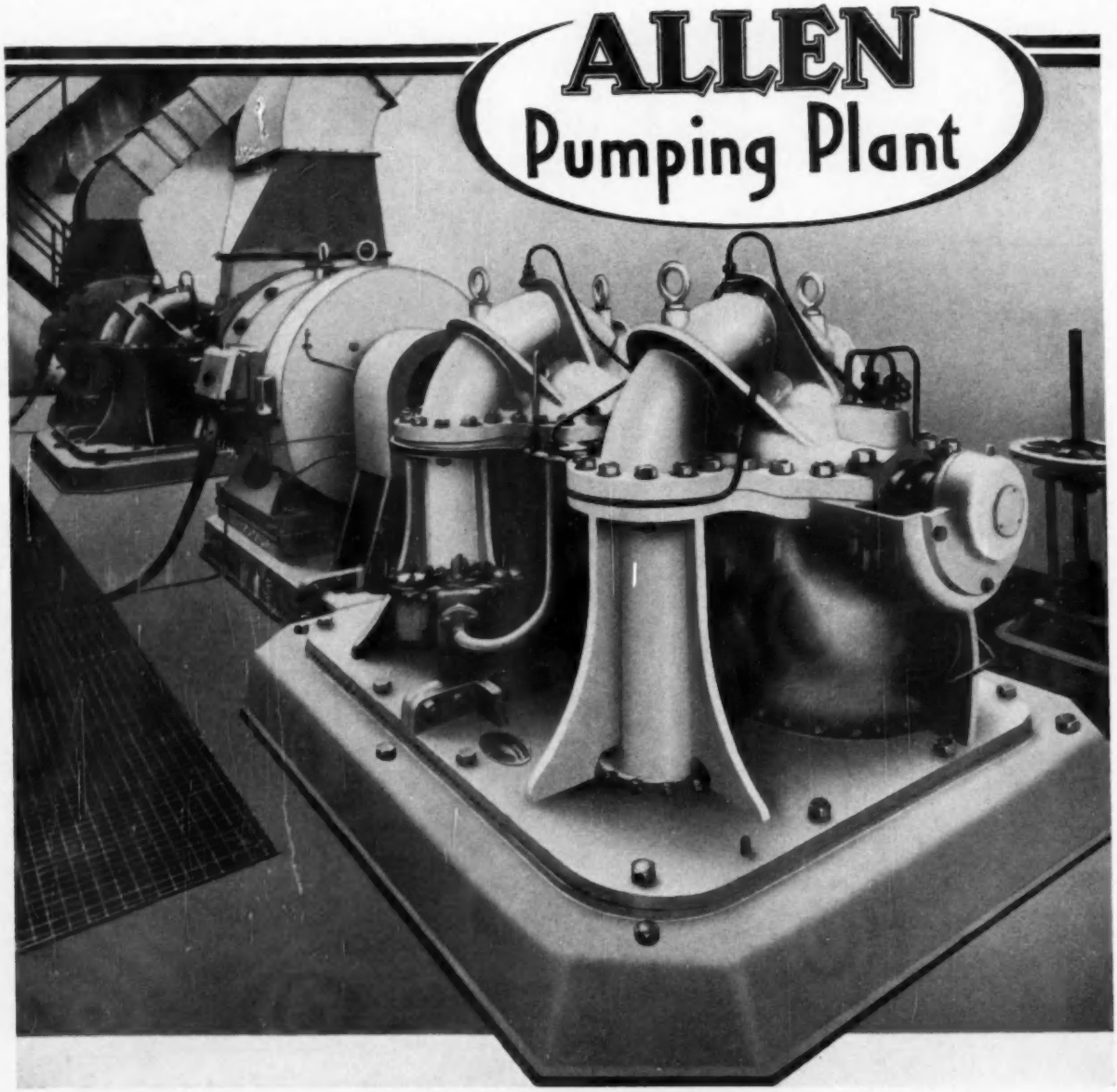
Sturtevant make dry or irrigated precipitators of all types—tubular, plate, single or dual voltage, and Sturtevant engineers are ready to collaborate in the application of this range of plant.

Full information of Sturtevant Electrostatic Precipitation is given in our publication J.7009.

STURTEVANT ENGINEERING CO. LTD.
Southern House, Cannon Street, London, E.C.4

AUSTRALIA

STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD. 400, SUSSEX STREET, SYDNEY, N.S.W.



for the ELECTRICITY SUPPLY COMMISSION OF SOUTH AFRICA POWER STATION, TAAIBOS

• • • •

The largest power station in SOUTH AFRICA

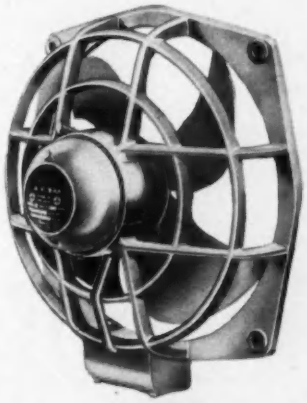
The installation comprises two Allen horizontal double-suction, two-stage pumping sets with a total capacity of 800,000 gallons per hour against a head of 475 feet, running at a speed of 1,485 r.p.m. The pumps are driven by 1,245-h.p. Metrovick motors and deliver water from the Vaal River to the power station for condenser cooling purposes.

Allen high-efficiency pumps, centrifugal and mixed-flow types for either horizontal or vertical operation, are designed to meet all requirements up to the largest capacity units needed in modern power station service.

Specialists in complete Pumping Plant installations

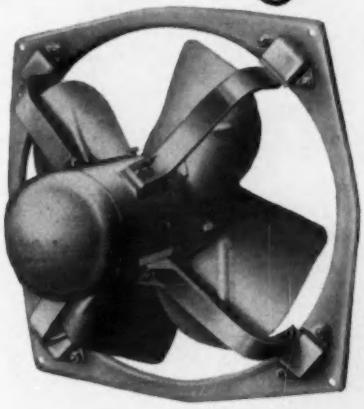
W. H. ALLEN SONS & Co LTD

BEDFORD **ENGLAND**



Quality

costs less in the long run



The quality of engineering in WOODS propeller fans means lasting reliability and economy from long service. Remember, WOODS are the world's most widely used fans, chosen internationally for performance and quality.

DELIVERIES FROM STOCK FROM ALL G.E.C. BRANCHES

Write for Publication V1220, it should be on your files.

WOODS propeller fans

WOODS OF COLCHESTER LTD., BRAISWICK WORKS, COLCHESTER

An Associate Company of The General Electric Co. Ltd., of England.

FAN ENGINEERS AT THE FOLLOWING BRANCHES: ABERDEEN, BELFAST, BIRMINGHAM, BRISTOL, CARDIFF, EDINBURGH, GLASGOW, LEEDS, LEICESTER, LIVERPOOL, LONDON, MANCHESTER, MIDDLESBROUGH, NEWCASTLE-ON-TYNE, NOTTINGHAM, SHEFFIELD.

CAPOSITE

single layer insulation

Saves a layer— retains higher insulating qualities

CAPOSITE is a 'one-layer' form of insulation. Used either as block or preformed section, there is no need to apply any type of heat resisting material before the main insulation. Yet National Physical Laboratory tests show that there is no increase of heat loss when CAPOSITE is applied direct. In fact, thermal efficiency has been rated as high as 98%, and even contact up to 1000°F. shows no tendency to shrinkage which would result in heat loss. Being made from the uniquely long-fibred South African asbestos known as Amosite, CAPOSITE is clean to handle, has a low breakage loss in transportation or storage, and its inherent strength enables it to be handled efficiently ir large size blocks and pipe section diameters and lengths.

CAPE

CAPOSITE...

Amosite Asbestos Blocks and Pipe Sections

Write for full technical details to:—

THE CAPE ASBESTOS COMPANY LTD. 114 & 116 Park Street, London, W.1. Tel: GROsvenor 6022

and at GLASGOW: Eagle Buildings, 217 Bothwell Street, Glasgow, C.2. Tel: CENtral 2175

MANCHESTER: Floor D, National Buildings, St. Mary's Parsonage, Manchester 3. Tel: Deansgate 6016-7-8

BIRMINGHAM: 11 Waterloo Street, Birmingham 2. Tel: Midland 6565-6-7

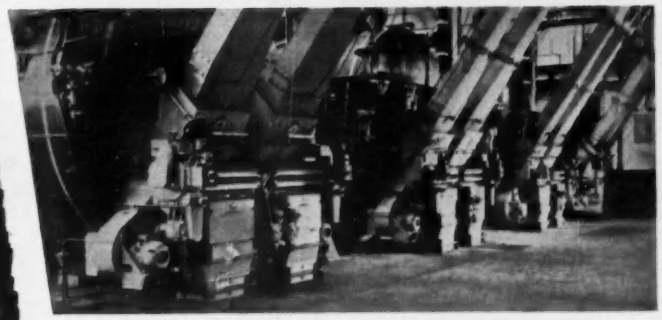
NEWCASTLE: 19 & 20 Exchange Buildings, Newcastle. Tel: Newcastle 20488.

T 11017A

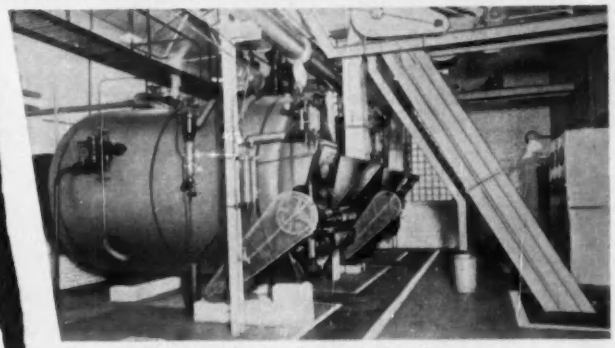
Is your problem smoke prevention?

Clearly BENNIS have the answer –in fact **two** answers!

With the CHAIN GRATE and "LOW RAM" Stokers for the firing of shell type and small water tube boilers Bennis offer two machines which give not only freedom from legislative action but a new economy. For smokeless combustion, higher thermal efficiency and fuel economy with maintenance costs reduced to a minimum, the answer is clearly BENNIS.



Bennis Chain Grate Stokers fitted to Economic boilers.



"Low Ram" Stokers fitted to Ruston & Hornsby Horizontal "Thermax" Economic boilers.

We can also supply Oil Fuel Burners and Auxiliary equipment with complete erection, pipework and storage tanks.

BENNIS
COMBUSTION LIMITED

LITTLE HULTON, WALKDEN, MANCHESTER
Telephone: WALkden 3213/4/5
LONDON OFFICE: Brettenham House, Lancaster Place, Strand, W.C.2.
Telephone: COVent Garden 2188

One of the Hodgkinson Group of Companies

WICKSTEED

REGD TRADE MARK

TUBE EXPANDERS

FOR ALL PURPOSES

As supplied to the Admiralty, Central Electricity Authority, Railways, Oil Refineries, leading Boiler Makers and Industrial users.

LEADING TUBE EXPANDER MANUFACTURERS FOR OVER 70 YEARS

CHARLES WICKSTEED & CO. (1920) LTD. KETTERING. Tel: Kettering 3113

BURBRIDGE BRONZE RENEWABLE SEAT VALVES

REDUCE MAINTENANCE COSTS AND TIME

- seat renewable in few minutes without disturbing valve or breaking joints.
- stainless steel valve and seat, precision machined.
- alternative valve discs for high pressure, low pressure, water and spirit.
- screwed or flanged valves can be supplied.

A REAL TIME & MONEY SAVER

DICK'S ASBESTOS AND INSULATING CO LTD

EAGLE WORKS

NORTH WOOLWICH ROAD, SILVERTOWN, LONDON, E.16

TELEPHONE: ALBERT DOCK 4311

BURBRIDGE VALVE PATENT NO. 57690 MADE IN ENGLAND BY BURROWS & BRIDGES LTD

DA 3.

WHITE CALCIUM-ALUMINATE CEMENT

(Over 70% Al_2O_3)

IRON COMPOUNDS & SILICA LESS THAN 1%

SECAR

250

Registered Trade Mark

Bonded with appropriate aggregate this cement provides Super-duty Castable Refractory Concrete for service temperatures up to 1,800°C (3,300°F) Refractory Concrete free from Iron Compounds & Silica is now possible for the first time.

A REFRACTORY CONCRETE FOR ANY PURPOSE

SECAR 250

is a product of

Lafarge Aluminous Cement Co. Ltd.

Manufacturers of

CIMENT FONDU

Regd Trade Mark

ALUMINOUS CEMENT

BECAUSE

Almost the entire Refractory field can be covered by Refractory Concretes based on SECAR 250 or CIMENT FONDU.

SECAR 250 concretes have all the well known properties of Ciment Fondu concretes

PLUS

- **HIGH PURITY**
- **HIGH REFRACTORINESS**
- **HIGH SLAG RESISTANCE**
- **HIGH COLD STRENGTH**
- **HIGH SPALLING RESISTANCE**
- **HIGH CASTING ACCURACY**
- **HIGH RESISTANCE TO CORROSIVE ATMOSPHERES**
- **NO SPECIAL PRE-FIRING PROCEDURE**

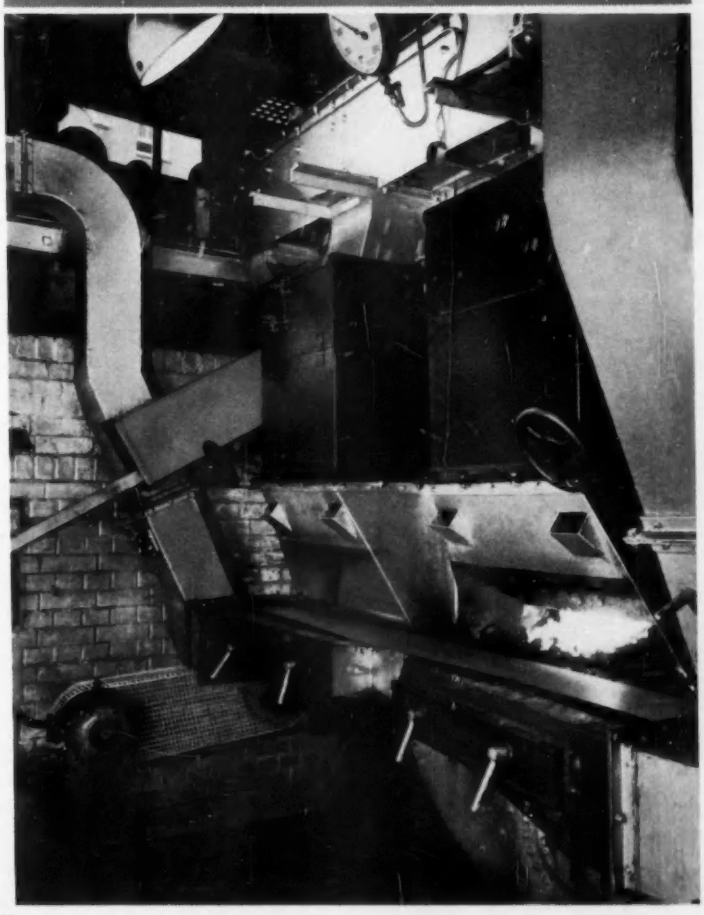
WRITE FOR BOOKLETS 'SECAR 250' AND 'REFRACTORY' CONCRETE

LAFARGE ALUMINOUS CEMENT CO. LTD. 73, BROOK STREET, LONDON, W.1. TEL.: MAYfair 8546

AP/48

This Gravity Feed Stoker . . .

. . . has recently been installed at **Guy's Hospital, London** where it replaces our Standard Stoker which had been in use for 25 years.



Crosthwaite Furnace Equipment is renowned for getting maximum heat from all grades of solid fuel at minimum capital cost. Comply with the Clean Air Act and see how much we can save you.

CROSTHWAITE

FORCED DRAUGHT FURNACES, MECHANICAL STOKERS AND COAL & ASH HANDLING PLANT

CROSTHWAITE FURNACES AND SCRIVEN MACHINE TOOLS LTD

York Street Ironworks, LEEDS 9 — *Tel. 3-2411 & 2*

32 Victoria Street, LONDON, S.W.1 — *Tel. ABBey 2966*

New Landmarks

IN BOILER DESIGN

240,000 lb/hour at 3,300 p.s.i. and 1,060°F

860,000 lb/hour at 1,600 p.s.i. and 1,010°F

Simon-Carves Ltd have broken new ground with two recent orders for boiler plant.

At Margam, for the Steel Company of Wales, they are building a once-through forced circulation boiler to generate 240,000 lb of steam per hour at 3,300 p.s.i. and 1,060° F with reheat to 840° F.

This is the first Benson-type boiler to be built in Britain and the steam conditions are the most advanced ever commercially used in this country.

At the Padiham 'B' power station of the Central Electricity Generating Board Simon-Carves are to build a 120-MW reheat boiler unit of the continuous-slagging type. This unit, which will generate 860,000 lb per hour of steam at 1,600 p.s.i. and 1,010° F with reheat of 785,000 lb per hour to 1,005° F, will be one of the first, if not actually the first, of this type to be built in this country.

It will convert the whole of the ash and the dust into slag and thereby both avert the nuisance of handling and disposing of fine ash and produce a usable product.

At the same time, Simon-Carves are busy at home and abroad on the design and construction of conventional boiler plant—a speciality in which they have long played a leading part.

Complete power plant
by ***Simon-Carves Ltd***

SIMON ENGINEERING GROUP

STOCKPORT. ENGLAND

OVERSEAS COMPANIES | *Simon-Carves (Africa) (Pty) Ltd: Johannesburg* *Simon-Carves (Australia) Pty Ltd: Botany, N.S.W.*

SC181

there's an

AIRETOOL

tube cleaner and tube expander for every type of tubular construction

---

Write, telegraph or telephone for complete information

ENGLAND SALES OFFICE

8 Woodland Way
Morden, Surrey, England
Telephone: Liberty 7039
G. B. Herbert, Sales Representative

●

EUROPEAN FACTORY AND WAREHOUSE

18 Industriweg
Vlaardingen, The Netherlands
Telephone: Vlaardingen 5254

SPRINGFIELD, OHIO, U.S.A.

toughest tube maintenance jobs are made easy with AIRETOOL equipment

See for yourself why so many refinery engineers specify AIRETOOL for their tube maintenance programs. AIRETOOL Equipment handles easy . . . is rugged, packs plenty of power and speed, won't bog down or break down during use. AIRETOOL does the *best* job, quickly, economically.

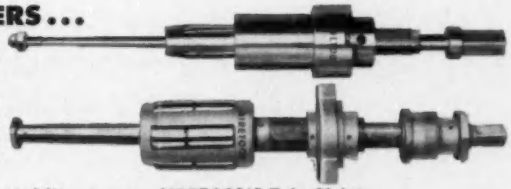
POWERFUL...FAST CUTTING TUBE CLEANERS quickly and thoroughly remove even hardest scale and deposits. Air driven motors in various sizes and speeds. P-Type cleaner head shown, is just one of many types available.

LIGHT...HANDY INTERNAL TUBE CUTTER

New . . . removes leaky or damaged tubes in *minutes!* Cuts steel or non-ferrous tubes through tube sheets 1" to 4" thick. Air or electric driven motor.

TUBE EXPANDERS...

Parallel rolling . . . self-feeding...AIRETOOL Tube Expanders roll tight, accurate tube joints with maximum bond, uniform expansion and tightness throughout full thickness of tube sheet.

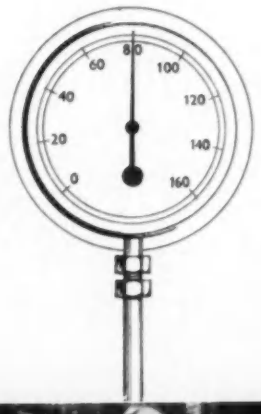


Write for illustrated literature on AIRETOOL'S Tube Maintenance Equipment, or see your nearest Airetool Representative.

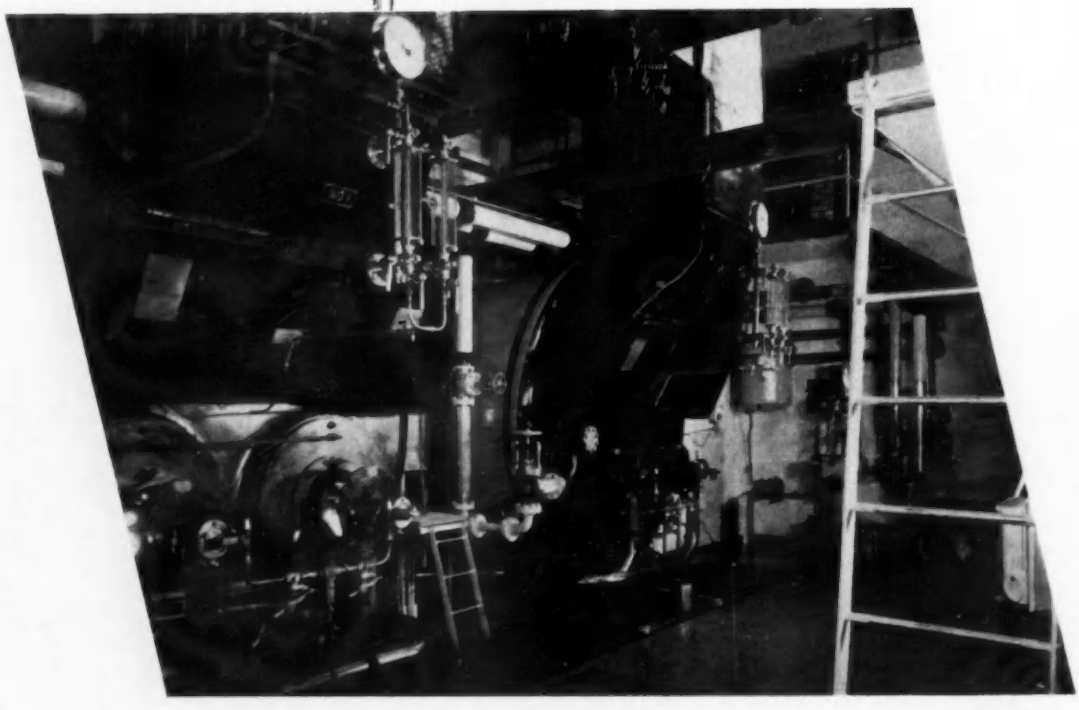
AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.
REPRESENTATIVES: in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands

Working at



MAXIMUM EFFICIENCY!



Messrs. Pye Ltd., of Cambridge, ensure that their Thompson Economic Boilers are kept at their maximum efficiency by using D.M. Boiler Solution

BY APPOINTMENT TO H.M. THE QUEEN
SPECIALISTS IN ORGANIC WATER TREATMENT

INTERNATIONAL SYMBOL OF SERVICE

HOUSEMAN & THOMPSON LIMITED

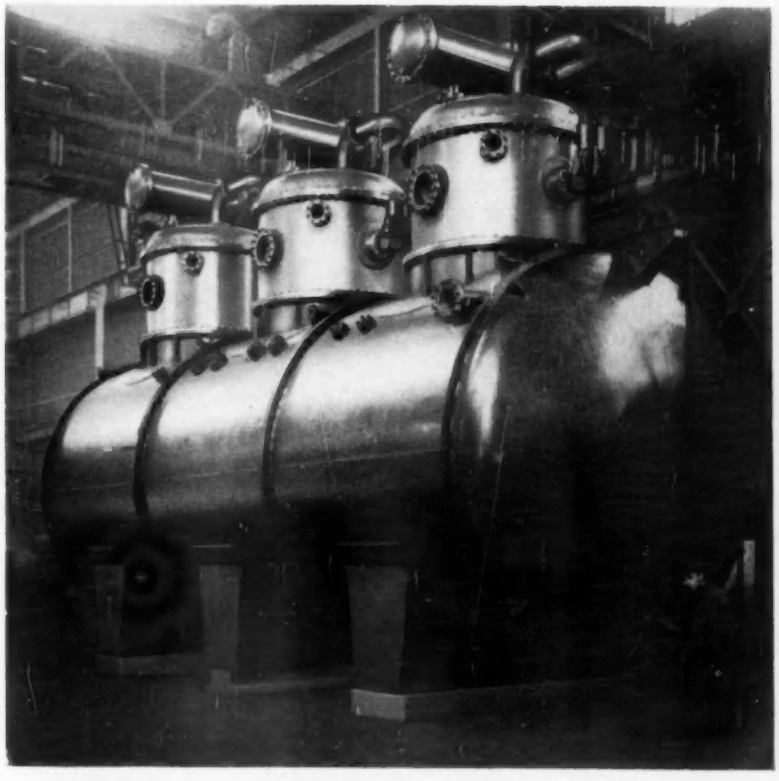
D.M. HOUSE · JESMOND ROAD · NEWCASTLE UPON TYNE 2

TELEPHONE : NEWCASTLE 81-2343/5

Branches at: LONDON SOUTHAMPTON YORK GLASGOW LIVERPOOL BELFAST

Weir DE-AERATORS

eliminate oxygen corrosion in the power plant



Prolong life of boiler tubes, economisers, valves and other surfaces.

Heat in operating steam retained in feed-water.

The Weir triple De-aerators illustrated are mounted on a feed tank 35 feet long, 12 ft. 6 in. diameter, and have a normal output of 1,040,000 lb./hr. at 280°F.

We invite enquiries for the most suitable equipment to meet specified requirements.

G. & J. Weir Ltd.

CATHCART · GLASGOW

Tri-Mor Refractories

make installation

easier

quicker

and cheaper

TRI-MOR GRADES

TRI-MOR Standard Castable
A medium texture refractory having negligible shrinkage up to 1,350°C. Suitable for casting special shapes or for monolithic structures. Limiting service temperature 1,350°C.

TRI-MOR High Strength Castable
A similar refractory to Tri-Mor Standard Castable, but specially developed to have very high mechanical strength over the lower temperature range. Maximum service temperature 1,250°C.

TRI-MOR High Temperature Castable
Suitable for face temperatures up to 1,600°C; has an extremely high resistance to thermal shock; used for cast in situ monolithic structures and for pre-cast refractory shapes; can be applied with a cement gun.

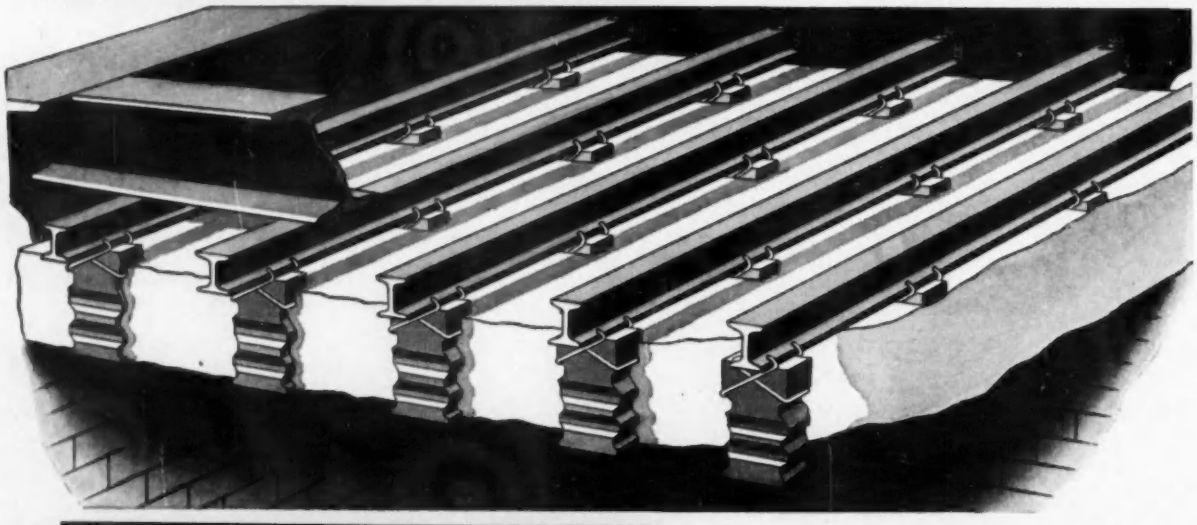
TRI-MOR High Temperature Mouldable
A plastic refractory for use up to 1,650°C: low shrinkage and a high resistance to spalling. Supplied mixed to the correct consistency for installation.

TRI-MOR Dense "Guncrete"
A hydraulic setting refractory with a maximum service temperature of 1,300°C. It has a high resistance to abrasion. Designed for application by cement gun, but can be trowelled.

TRI-MOR Insulating Castable
An insulating castable for maximum service temperatures of 1,200°C; low thermal conductivity is its main feature.

TRI-MOR Insulating "Guncrete"
Similar to Tri-Mor Insulating Castable but for application by cement gun.

Full details of each grade are available on request.

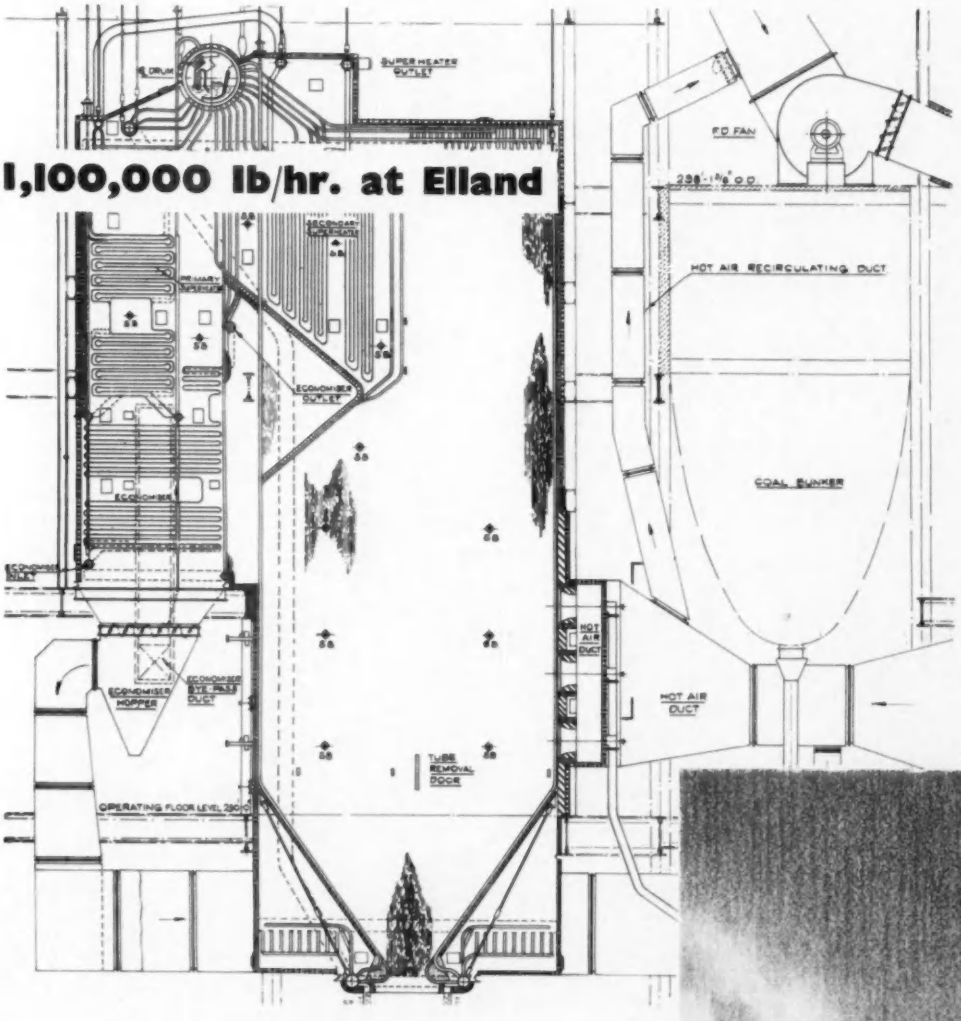


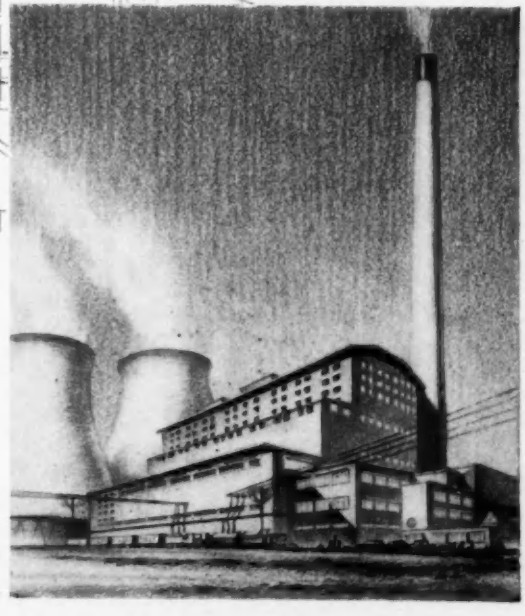
Soaking pit cover in Tri-mor High Temperature Castable with ceramic keys.

MORGAN Refractories Ltd

For further information please write to: MORGAN REFRACTORIES LTD. NESTON, WIRRAL, CHESHIRE. TEL: NESTON 1406 NE 136

1,100,000 lb/hr. at Elland





At the Elland Power Station of the Central Electricity Generating Board we have been entrusted with the installation of 2 steam generators each of 550,000 lb/hr. together with their auxiliaries.

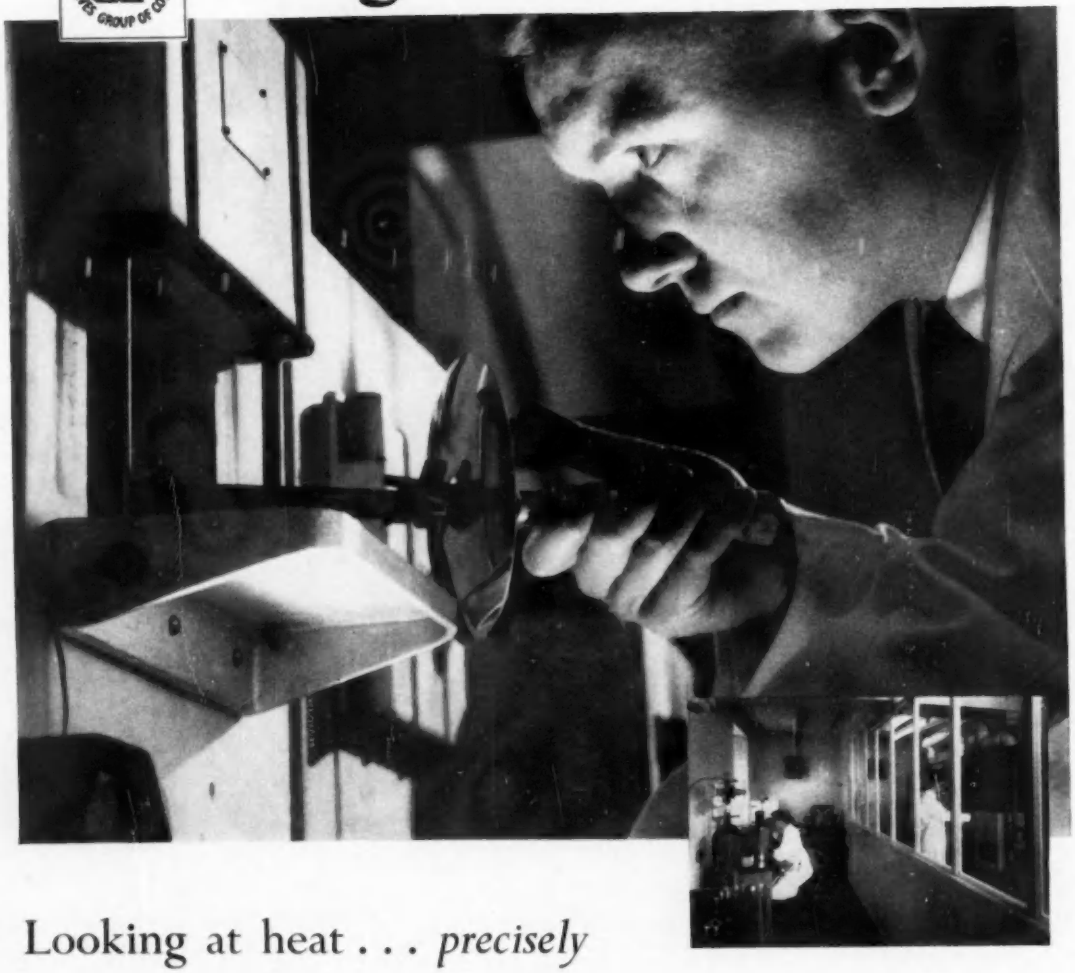
For the same authority we are building many other boilers ranging from 320,000 lb/hr. to 880,000 lb/hr.

JOHN BROWN LAND BOILERS LTD

WHITECROOK CLYDEBANK GLASGOW

8 THE SANCTUARY *London Office: WESTMINSTER* *LONDON, S.W.1*

Hargreaves *in action!*



Looking at heat . . . *precisely*

Accurate assessment of quality is essential if Industry is to make the best use of Coal, Coke and Fuel Oil. In the Hargreaves Laboratories, equipped with bomb calorimeters, furnaces and pyrometers, qualified technical staff have fuel samples constantly under test. HARGREAVES sell Heat and their free technical services ensure that the customer gets the utmost value for money.

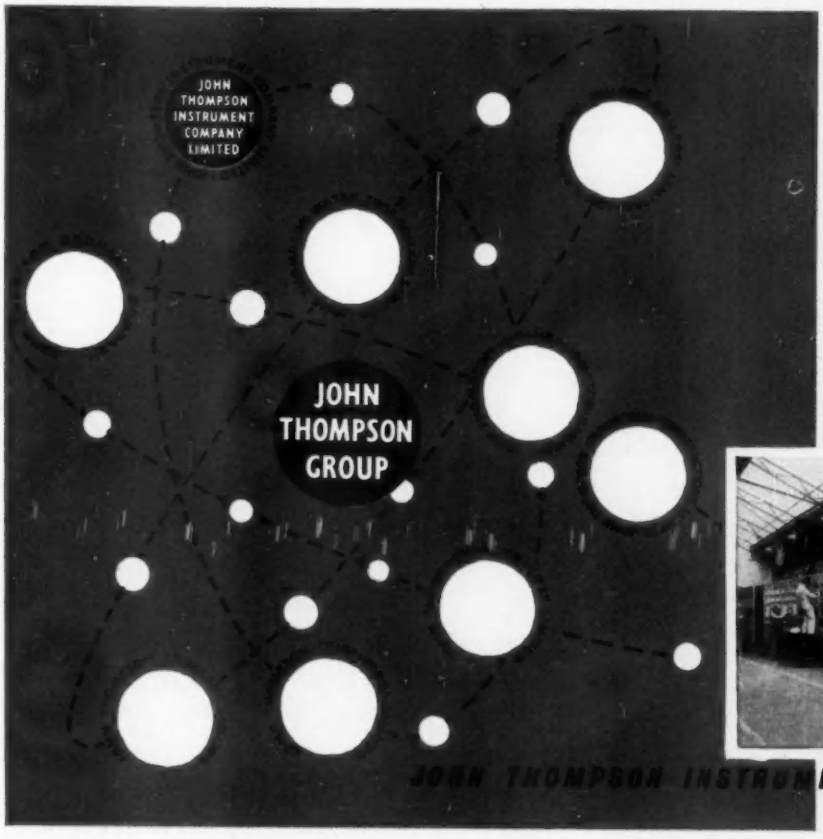
HARGREAVES

FUEL DISTRIBUTORS

Bowcliffe Hall, Bramham, Boston Spa, Yorks. (*Phone Boston Spa 2081*)

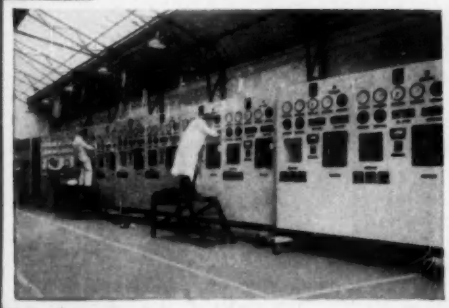
LEEDS • LONDON • NEWCASTLE • HULL • GLASGOW • BLACKBURN • MANSFIELD • HUDDERSFIELD

10804d



INSTRUMENTATION

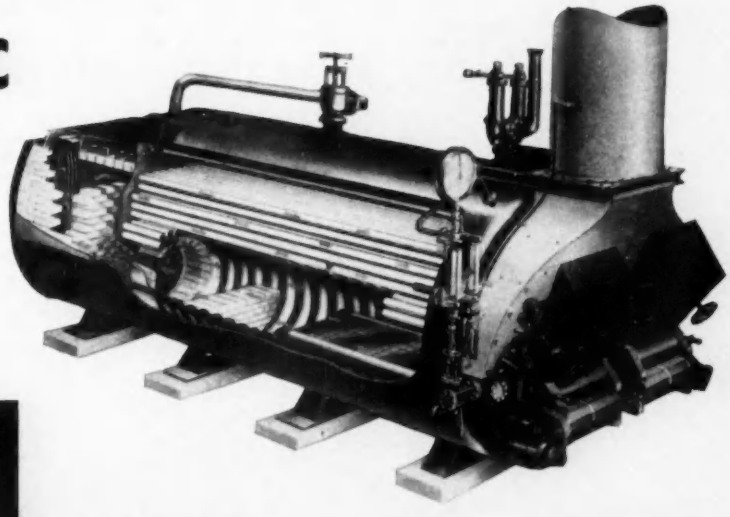
In recently extended premises, the John Thompson Instrument Company Ltd., produces measuring, recording, and auto-controlling instruments and undertakes complete instrumentation including panelling, wiring and pipework for steam-raising, chemical process, foundry and nuclear power plant. Instrument panels seen here in course of production are for the Dounreay fast reactor heat exchange plant.

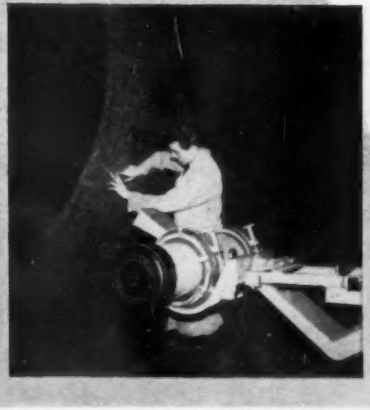


JOHN THOMPSON INSTRUMENT COMPANY LIMITED
WOLVERHAMPTON

ING/1

ECONOMIC BOILERS





The Wilson Double Pass Economic Boiler has additional heating surface provided by a return pass of smoke tubes to the front of the boiler. This arrangement not only gives a high efficiency, but makes a very compact unit, self contained and requiring no brickwork setting. As illustrated the boiler has a Thompson-Triumph travelling grate stoker and superheater, but other equipment can be furnished as required.

Left: Fusion welded boiler shells are examined by modern radiographic methods.

JOHN THOMPSON (WILSON BOILERS) LTD
LILYBANK WORKS · LONDON ROAD GLASGOW E.1

GI/4

500 High Head...

UP TO 500 FEET

THE SIGMUND PERIPAK PUMP gives a very high head (up to 500 feet) and quantities up to 25 g.p.m. *from a single stage.*

Yet minimum working space is required for the PeriPak, pump and motor being of integral construction, mounted on single shaft and contained in a robustly constructed foot-mounted support frame.

STOCK
Over a thousand pumps always in stock at the Sigmund Factory. (See Sigmund Stock List, available on request.)

SERVICE
First class service, advice and prompt quotations available from Sigmund Branches throughout United Kingdom and Eire.

SIGMUND PeriPak

SIGMUND PUMPS LIMITED

TEAM VALLEY GATESHEAD, 11
Tel: LOW FELL 7-5051 (10 lines)
LONDON: Tel. Sloane 2201/4. BELFAST: Tel. Belfast 25541. BIRMINGHAM: Tel. Midland 6644. DUBLIN: Tel. 67215/6. GLASGOW: Tel. Central 8411. LEEDS: Tel. 3-4565. MANCHESTER: Tel. Deansgate 7746. NEWPORT (MON.): Tel. Newport (Mon.) 63446.

41/A

Introducing the NEIL CONVEYOR STOKER

Designed and built after a careful survey of the problems associated with the mechanical firing of Lancashire and Economic Boilers.

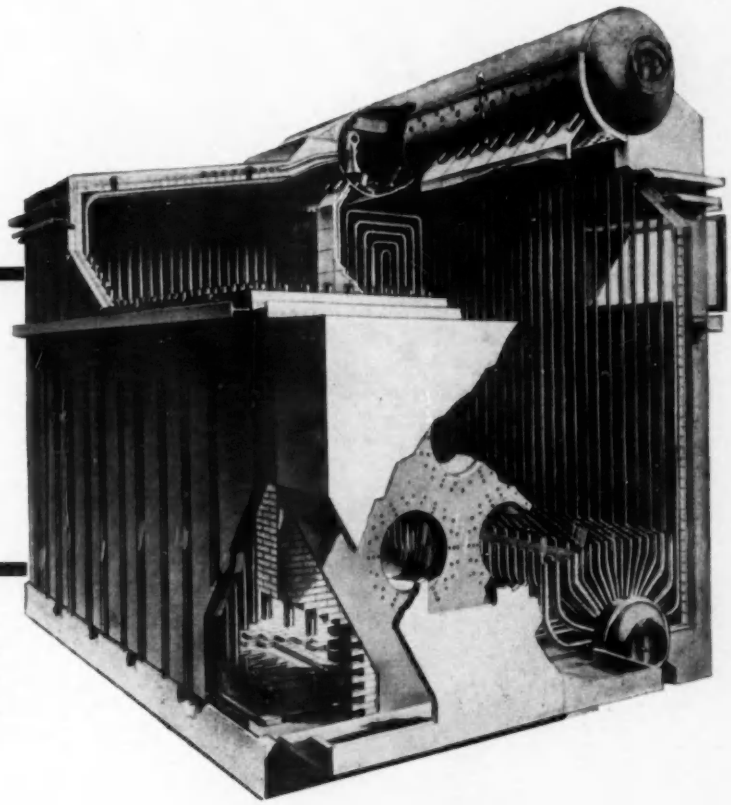
While retaining the best proved features of the Coking Stoker, it provides in practice all the desirable advantages of a Chain Grate, thus securing a combination of mechanical and combustion efficiency.

J. & J. NEIL (TEMPLE) LIMITED

Combustion Engineers

GLASGOW·W3 Phone: SCOTSTOUN 6571-2 Grams: Rocker Phone Glasgow

Series "SC" STANDARD Steam Generator



Fuels: Oil or Gas
Capacities: 50,000 to 150,000 lb./hr.
Steam Pressures: to 1,500 psi.
Steam Temperatures: Superheat temperatures to 950°F.

PRE-ENGINEERED FOR SAVINGS

in first cost, installation, operation, maintenance

Series " SC " Steam Generator is a pre-engineered, standardized design, with all exterior and structural details fixed. Available in nine sizes, with capacities of 50,000 to 150,000 lb. steam per hr., it incorporates advanced design features that make possible important savings in industrial steam costs.

Burners, controls, upper drum mountings and other equipment requiring attention are located at the front of the unit. Heat recovery equipment and fans can be placed near the operating aisle for either single or multi-unit installations, providing unusual accessibility and ease of operation.

Write today for further information. We shall be glad to explain how the Series " SC " Standard Steam Generator can meet your *individual plant needs for power or process work.*

FEATURES AT A GLANCE

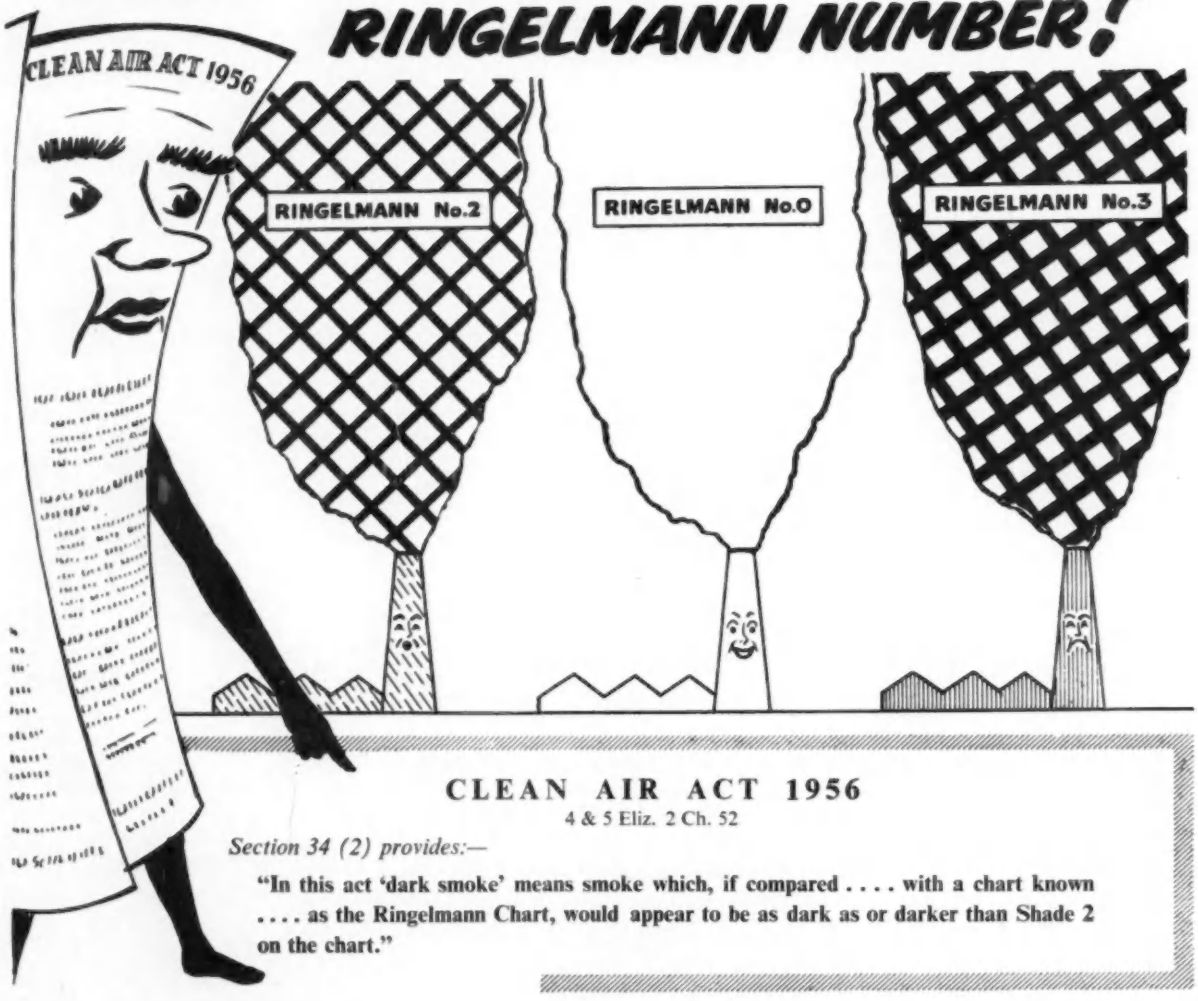
- *Completely water-cooled furnace.*
- *Over 19-foot firing depth.*
- *Unrestricted circulation.*
- *All-welded casing.*
- *Fully drainable superheater.*
- *Efficient convection surface.*
- *Bottom supported unit.*
- *Steam purifying system.*
- *Full insulation.*

FW

FOSTER WHEELER LIMITED

FOSTER WHEELER HOUSE, 3 IXWORTH PLACE, LONDON S W 3

What is YOUR RINGELMANN NUMBER?



CLEAN AIR ACT 1956

4 & 5 Eliz. 2 Ch. 52

Section 34 (2) provides:—

"In this act 'dark smoke' means smoke which, if compared . . . . with a chart known . . . . as the Ringelmann Chart, would appear to be as dark as or darker than Shade 2 on the chart."

No. 3 RINGELMANN
IS A FLAGRANT OFFENCE UNDER THE ACT

No. 2 RINGELMANN
FAILS TO COMPLY WITH THE ACT

No. O RINGELMANN
IS ASSURED WITH THE

OLDBURY
CHAIN GRATE STOKER

which anticipated the Clean Air Act by 14 years

Today more than 5,000 Oldbury Stokers are serving industry, burning solid fuels in the widest variety, **EFFICIENTLY, SMOKELESSLY.** **Leave nothing to doubt. To comply with the Act, consult Edwin Danks at Oldbury or the nearest Branch Office.**

EDWIN DANKS & CO. (OLDBURY) LTD.
OLDBURY near BIRMINGHAM · Tel: (Stoker Division) Brierley Hill 7731
LONDON · CARDIFF · GLASGOW · LEEDS · MANCHESTER · NEWCASTLE-ON-TYNE

Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

JULY 1958

VOLUME 73. No. 7

Principal Contents

	Page
EDITORIAL NOTE	211
POINTS AND POINTERS	212
TILBURY POWER STATION	214
PEACEFUL USES OF ATOMIC ENERGY IN AUSTRALIA	220
NEW BOARD MILL AT THATCHAM	223
STANDARD CONTROL FACILITIES FOR THE NATIONAL ELECTRICITY GRID	229
TWENTY-FIVE YEARS PROGRESS AT DANFOSS	231
CENTRAL BOILER PLANT INSTALLATION AT DERBY WORKS OF ROLLS-ROYCE LTD.	235
RECENT EQUIPMENT AND ACCESSORIES	238
LATEST POWER PLANT PATENTS	244
NOTES—PERSONAL AND INDUSTRIAL	248

The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

Published monthly by

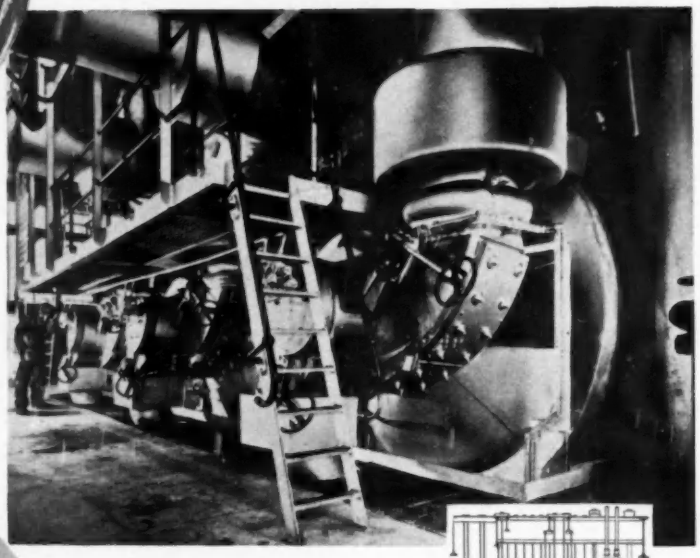
ENGINEERING REVIEW PUBLISHING CO. LTD.
19-20, NOEL STREET, LONDON, W.1

Annual Subscription Rate, 40s., including postage.

Telephone
Gerrard 8811

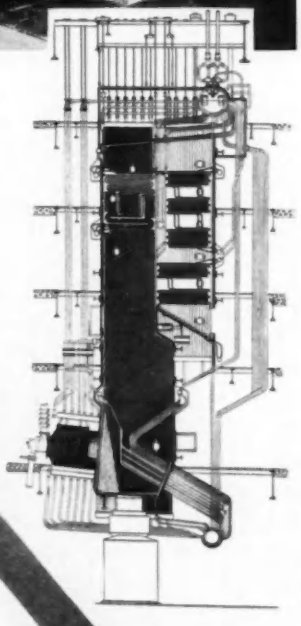
Telegrams
" Farsighted, Wesdo London "

BOILER No. 44



First Cyclone-fired central-station boiler in Britain . . .

Barking, with its A, B and C stations is one of the largest single concentrations of central-station generating plant in Europe, with a total installed capacity of $\frac{3}{4}$ million kilowatts. All 44 boilers at Barking are BABCOCK units and the latest, No. 44, is the first central-station unit operating in Great Britain with Cyclone-firing. This is a Radiant boiler with an output of 540,000 lb./hr. at 950 lb./sq. in. and 940°F, equipped with three 8-ft. diameter Cyclone Furnaces burning crushed coal, with axial entry.



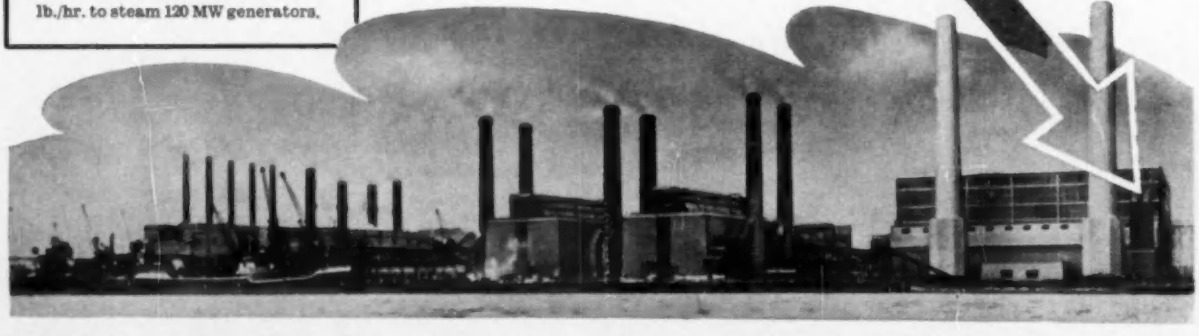
Solves the ash-disposal problem

The Cyclone Furnace, by converting the ash to a granular slag that is easily handled and readily usable on civil works, provides an effective, economic solution of the ash-disposal problem. It burns a wide range of coals with high efficiency; improves boiler-availability; is safe, flexible in operation and well-suited to simple automatic combustion control.

Over 100 BABCOCK Cyclone-fired boilers

are ordered or in service in various countries. In Britain, units in service, under construction or on order, range from large industrial boilers of 200,000 lb./hr. up to central-station units of 860,000 lb./hr. to steam 120 MW generators.

BABCOCK *Cyclone-fired* BOILERS



BABCOCK & WILCOX LTD., BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.I.

Engineering and
BOILER HOUSE REVIEW

JULY 1958

VOLUME 73 No. 7

NUCLEAR POWER STATIONS MUST BE CHEAPER

THE need for making the fullest possible use of the electricity to be generated in nuclear power stations—and the necessity of bringing down the cost of nuclear power plants, were emphasised by Sir Christopher Hinton, K.B.E., F.R.S., chairman of the Central Electricity Generating Board, at the annual Electrical Power Convention which was held at Brighton during the week June 16th-20th. He said the alternative was either to swing back to the use of coal-fired power stations, or to produce electricity more expensively than it could be produced in conventional plants. Sir Christopher recalled that this country's programme for the industrial use of nuclear power was published as a White Paper in 1955, and called for the construction of 1,800-MW of generating capacity by 1965—equivalent to an annual coal consumption of 5 million tons. This was thought to be a reasonable compromise between the serious long-term coal shortage and the realisation that nuclear power was still untried. It was anticipated that the power costs would be in the region of 0.6d. per kWh—a figure which allowed for a plutonium credit of about 0.35d. per kWh.

In March, 1957, the programme was expanded, and the target for 1965 lifted from the initial level of 1,500/2,000-MW to a level of 5,000/6,000-MW. Research into plutonium burn-up figures and the fast reactor, had by this time shown that plutonium credit prices at the level originally set could not be justified, and in addition, the " scarcity value " was reduced because the U.S.A. had decided to make available considerable quantities of enriched uranium through the International Agency. At the same time, capital costs as shown by the C.E.A. tenders were somewhat lower than expected, but not sufficiently to offset the reduced plutonium credit figure 0.07d. per kWh. The estimated overall cost/kWh sent out had risen over the months from 0.6 to 0.66 pence.

The large expansion of the programme which was adopted in 1957 brought with it another major problem. The cost of electricity generated in nuclear power stations had been based on the assumption that these stations would operate as base-load stations with an annual load factor of 75 per cent. To use nuclear stations in such a way was obviously wise because of their high capital cost; but it was a privilege which they could not enjoy indefinitely unless system load factors were considerably increased, by, for example, three-shift working in industry. At present the load factor on the British electricity supply system was under 50 per cent., and the minimum continuous load was only about 3,000-MW. This occurred at night, during week-ends in the summer and was, in effect, the base-load on the system.

Sir Christopher indicated that once the base-load requirement had been filled—which would be by stations beginning construction in 1966/67—then contracts for nuclear plant might reduce to 300-MW to 400-MW per annum, accommodating only the base-load increase.

In any case, coal-fired power stations are now to be built after 1966/67 and at a rate in excess of 50 per cent. of that obtaining today—and this in spite of the many forecasts which we have heard uttered that an all-nuclear programme would be with us in eight to ten years time. Thus, it appears that after 1969, and again if the nuclear stations had an availability of 100 per cent., some of the stations would be required to reduce output at night during the week, and at week-ends. Nuclear capacity in 1970 would have exceeded the continuous load on the system and these stations, therefore, must be capable of flexible operation, as they must operate at load factors of less than 75 per cent. In these circumstances, nuclear power could only continue to compete if the capital cost per MW had been considerably reduced; and this reduction must have been achieved by 1966, because it was at that date that the plants would be ordered and designed. Because of financial restrictions imposed last year, the attainment of the target of 5,000/6,000-MW of nuclear power by 1965 might be delayed by about twelve months.

If flexibility of operation could not be built into these nuclear stations, and if their capital cost could not be reduced to the point where they could generate electricity as cheaply as conventional plants on a reducing load factor, then in order to make good the deficit, the amount of conventional plant would have to be increased to about 2,000-MW per annum.

Points and Pointers

BIRTHDAY HONOURS The birthday of Her Majesty the Queen was officially celebrated on Thursday, June 12th. An Honours List published on that day includes the names of a number of men who are well known in the electrical power and allied industries. In the Civil Division of the Order of the British Empire, the honour G.B.E. is conferred upon Lord Citrine, P.C., K.B.E., who was chairman of the former Central Electricity Authority, and is now part-time member of the Electricity Council. Knighthoods are conferred upon Dr. Willis Jackson, director of research and education, Metropolitan-Vickers Electrical Company Ltd. ; Mr. J. S. Pickles, chairman, South of Scotland Electricity Board ; and Mr. C. A. P. Southwell, managing director, Kuwait Oil Company Ltd. Among the recipients of the K.B.E. is R. J. Ayres, deputy secretary, Ministry of Power. Commanders of the Order of the British Empire (C.B.E.) include Mr. D. Bellamy, chairman, Yorkshire Electricity Board; Mr. T. W. F. Brown, director, Pametrada ; Mr. J. Cowan, principal electrical inspector (Mines Inspection) Ministry of Power ; Mr. J. L. King, resident engineer in London of the Electricity Corporation of Nigeria ; Dr. R. Lessing, president, National Society for Clean Air ; Dr. W. A. Macfarlane, chief executive, National Insurance Fuel Efficiency Service ; and Mr. G. H. Wilson, chairman and managing director, Laurence Scott and Electromotors Ltd. The list of officers of the Order of the British Empire (O.B.E.) include Mr. T. C. Crawhall, assistant director, Mechanical Engineering Research Laboratory D.S.I.R. ; R. W. Reynolds-Davies, secretary, Institute of Fuel ; Mr. F. J. Dent, director of research, Gas Council, Midlands Research Station, Solihull ; Mr. J. N. Macfarlane, chief accountant, Ministry of Power ; Mr. S. S. Scott, chief personnel officer, C.E.G.B.; and Mr. R. P. M. Wright, engineering manager, Harland and Wolff Ltd.

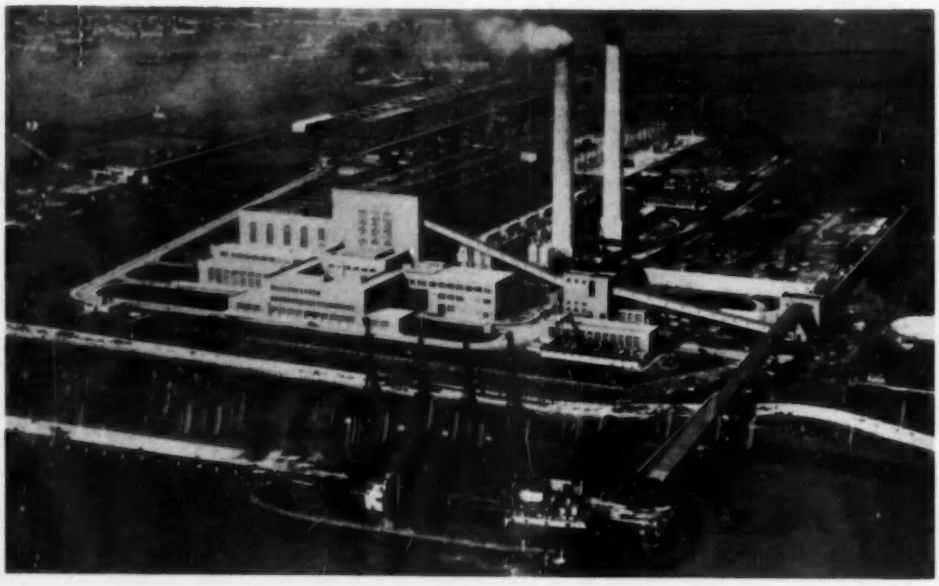
THE INSTITUTE OF FUEL— PRESIDENT ELECT The Institute of Fuel has elected an "oilman," Mr. T. C. Bailey, to become president in October of this year. This will be only the second time that a member of the oil industry has occupied this office, the previous "oilman" president being Lord Cadman, who was president in 1935-36. Mr. Bailey was educated at Haberdashers' Aske's School, Cricklewood. His career since leaving school has been spent in the marketing side of the oil industry. He first entered the Fuel Oil Department of the Anglo-Mexican Petroleum Company, transferring in 1921 to Shell-Mex Limited on the amalgamation of the Shell and Mexican interests, and then to Shell-Mex and B.P. Limited on the further amalgamation with the British Petroleum Company Limited in 1932. For many years he devoted his attention to the application of fuel oil to industrial furnaces and during World War II was seconded to the Petroleum Board to play a leading part in developing the use of creosote pitch mixtures as fuel. After the war he was closely concerned with the development of oil-fired open hearth steel furnaces. In 1954 he was appointed sales manager (Industrial Fuels) of Shell-Mex and B.P. Limited. He joined the Institute in 1938 and was elected a Fellow in 1947. He has served on council since 1951 and became a vice president in 1957. He is a member of finance and general purposes and publication committees, and succeeded the late Dr. G. E. Foxwell as chairman of membership committee. Mr. Bailey was chairman of the organising committee of the special study of "drying" which was held in 1950-51, and is now chairman of the committee which is organising the conference on liquid fuels, to be held at Torquay in May, 1959.

MECHANICAL STOKERS IN SMOKE CONTROL AREAS The Coal Utilisation Council has recently presented a memorandum to the Minister of Power, inviting him to represent to the Minister of Housing and Local Government that it would be desirable for a general exemption to be given, under the appropriate section of the Clean Air Act, 1956, to furnaces fired by mechanical stokers, in smoke control areas established under the Act. This memorandum pointed out that an exemption had already been granted for oil-fired boilers, provided that they were so installed, maintained and operated as to minimise the emission of smoke ; it was, therefore, submitted that mechanically-fired boilers using coal should be granted a similar exemption, subject to a similar safeguard. Such an exemption, the council said, would permit small coal to be burned efficiently, with the same degree of smokelessness as oil, and ensure that maximum use continued to be made of indigenous as opposed to imported fuel. It would also serve to minimise sulphur emission, since in general the sulphur content of industrial coals is less than that of imported fuel oils. Although the Act permits local authorities to grant exemptions (and a number have already done so), a Ministerial exemption, it was urged, would secure uniformity of action over the whole country, and property owners and architects contemplating the use of mechanical stokers would not need to become familiar with different requirements of different authorities. The Coal Utilisation Council pointed out in the memorandum that if there were no Ministerial exemption and no general exemption in a local authority's smoke control order, mechanically-fired boilers could not be installed unless an emending order was made. Furthermore, uncertainty as to the attitude that local authorities would adopt would discourage prospective users from even considering the installation of mechanical stokers in any area that might become subject to smoke control ; this would have the most adverse effect on the development of an important section of solid fuel appliance industry. It would also discourage the promising research work, at

present in progress by the British Coal Utilisation Research Association, and elsewhere, on the development of small mechanical stokers, for the smokeless combustion of coal. In the introductory section to its memorandum, the council points out that although its task was to promote the efficient domestic use of solid fuel, and the principal use of mechanical stokers was for the firing of industrial furnaces, the use of these stokers in large residential establishments, schools and similar installations represented an important and efficient use of coal, which might be expected to increase as central heating increased in popularity. The memorandum pointed out that the exemption of mechanically fired boilers would be in the interest of various of the Council's constituent organisations, i.e., the National Coal Board, the Chamber of Coal Traders, the Co-operative Union, and the Combustion Engineering Association (with which the Council was in close touch during the preparation of the memorandum).

INCORPORATED PLANT ENGINEERS The eleventh annual conference of Incorporated Plant Engineers was held at the Grand Hotel, Brighton, a few weeks ago. The theme of the conference was " The opportunities of change," with of course, special reference to the introduction of new techniques by plant engineers. On the first day of the conference, the annual general meeting was held, at which the report of the council and the accounts for 1957 were received and adopted. Later the president presented Mr. G. Bradley with the silver medal (and also a cheque), and Mr. G. D. Jordon with the bronze medal (and a cheque), as winners of the 1957 Alexandra Duckham Memorial Awards. During the evening the delegates attended a civic reception, and afterwards a dance, at the invitation of the Mayor and Mayoress of Brighton (Alderman and Mrs. Charles Tyson). One of the main items on the conference agenda was the induction of Mr. K. S. London as twelfth president of Incorporated Plant Engineers. In formally introducing Mr. London, the retiring president (Mr. Vincent Taylor) spoke of Mr. London's character, ability, and qualifications, and wished him success during his year of office. Mr. Taylor also took the opportunity of thanking the council and all concerned for the encouragement and support which he had received during his own term of office. In his presidential address, Mr. London made reference to the industrial conditions which prevailed during the last century and which gave this country the opportunity to become what has often been termed " the workshop of the world." He said that not only had these conditions changed completely, but they would continue to change as most of the nations of the world made efforts to improve their individual standards of living by means of widespread industrialisation. Our standards will depend he said, upon our ability to adapt ourselves to the far-reaching changes, and also upon our capacity for seeking opportunities for change by applying the results of research quickly enough to allow us to remain one step ahead of our competitors. The first technical contribution to the conference was a paper by Mr. H. Birchall, B.Sc. (Tech.), engineering director, Dyestuffs Division, I.C.I. Ltd., entitled " Some Current Techniques and Future Trends in the Planning of Plants and the Operation of Processes." Numerous delegates took part in the discussion which followed the paper, and which was opened by Mr. G. A. Rooley, A.M.I.Mech.E., a past president. As at previous conferences, various discussion groups dealt with subjects of special interest to the plant engineer. At the conference dinner, the principal toast, after the loyal toast, was that of " The Institution," proposed by Engineer Rear Admiral Sir Sydney Frew, K.C.B., C.B., chief fuel engineer to the Ministry of Power. This toast was replied to by the president. " The Guests " was proposed by Mr. W. M. Barber, M.A.(Cantab), A.M.I.Mech.E., a vice-president of the Institution, and was replied to by Mr. C. S. Rees, B.Sc., manager, production, of The Associated Ethyl Co. Ltd. The final technical contribution was a paper by Mr. L. Landon Goodman, B.Sc. (Eng.), A.M.I.Mech.E., (industrial specialist of the British Electrical Development Association)—the title of the paper being " Industrial Progress and the Plant Engineer."

SLURRY FOR STEAM RAISING The West Fife Area of the Scottish Divisional Coal Board recently announced that the boilers in the new experimental power station at Bowhill, Ayrshire, which use coal slurry as fuel, effected a saving of £66,000 during the first year's operation. It is claimed that this is the first British power station to use this type of fuel and that 35,000 extra tons of better quality coal have in consequence been made available to the industrial market. It appears that the West Fife Area is planning to install two more slurry-burning boilers in the central power station at Kelty, which, together with Bowhill, will supply the entire electrical load required by the 24 collieries in West Fife, and will effect an estimated annual saving of approximately £198,000. The burning of slurry and other low-grade refuse from washeries and from material taken out when new underground roads are being driven or new coal faces opened up has long been an object of policy not only in the coal-mining industry but also among those concerned with the enormous amount of new land required year by year to accommodate the waste material in spoil heaps—estimated by the Beaver Committee on air pollution to be about 750 to 1,000 acres a year. The Ayrshire developments have not been the only ones. For some years, experiments have been going on at Llay Main Colliery, near Wrexham, where a plant comprising Daniel Adamson boilers, and with an output of 50,000 lb. of steam an hour is running successfully and economically and was recently duplicated. A more recent plant is that at the 60-MW Barony power station of the South of Scotland Electricity Board where four Babcock & Wilcox 150,000 lb./hr. boilers use as fuel slurry or filter cake from the coal preparation plant at the adjacent Barony Colliery. This installation was described and illustrated in the March, 1958, issue of this journal. It is to be hoped that the technique of slurry burning in the furnaces of boilers of appreciable size will become even more extensive, particularly as the disposal of this sticky, putty-like material has for many years been a serious problem, and in view of the fact that the handling difficulties have now been largely overcome. It appears that the secret of handling slurry successfully is to keep it on the move and, as a result of this discovery, suitable plant for the purpose has been designed and installed at Barony by Babcock & Wilcox Ltd.



Tilbury Power Station

THE 360-MW power station at Tilbury in the Eastern Division of the Central Electricity Generating Board was formally opened on June 6th, 1958, by Col. Sir Francis Whitmore, Bt., K.C.B., C.M.G., D.S.O., T.D., J.P., H.M. Lieutenant of the County of Essex. The station, originally planned for nine boiler/turbo-alternator units, contains six, each rated at 60-MW—the first commissioned in September, 1956, and the sixth some 15 months later in December, 1957.

Negotiations for the acquisition of the Tilbury site were commenced in 1947 by the County of London Electric Supply Co. Ltd., under the leadership of the late Mr. W. J. H. Wood, acting in conjunction with the Central Electricity Board. In April 1948, when the British Electricity Authority was established, responsibility for the project passed to the Authority's Eastern Division, and the design and construction of the station has from that time been under the direction of the Divisional Controller, Mr. W. N. C. Clinch, M.I.E.E., F.Inst.F. The main consulting engineers were Messrs. Merz and McLellan, and the associated civil consulting engineers and architects, Sir Alexander Gibb & Partners.

Building and civil engineering work

The first civil engineering contract was placed in 1950, and included, in addition to the access road and railway, the construction of a reinforced-concrete bridge spanning the Tilbury-Southend railway line. This bridge provides an uninterrupted access to the site and is also used by the general public, as it replaces a level crossing.

Site conditions made it necessary for the foundations of the station buildings to be erected on pre-cast reinforced-concrete piles, and a total of some 13,000 piles were driven, these having an average length of 55-ft. All the buildings, including the offices and workshops, are of steel-framed construction, clad with London stock bricks. The reinforced-concrete chimneys are 330-ft. high, coloured concrete being used to blend with the station brickwork.

Apart from the station buildings, civil engineering work included the construction of a reinforced-concrete jetty, and the circulating-water system. The jetty is 400-ft. in length and incorporates facilities for unloading coal from ocean-going colliers, and also, of course, at the present time, fuel oil from 5,000-ton oil tankers. An upstream arm of the jetty, some 300-ft. in length, is arranged to accommodate plant for loading ash into sea-going barges. The circulating-water system consists of a 11-ft. 8-in. diam. water tunnel from a vertical intake shaft under the jetty to screen and pumping chambers behind the river bank. The pump and screen chambers were constructed inside a caisson 118-ft. by 76-ft. which was built at ground level and sunk to the required foundation level of 60-ft. below ground level by excavating within the structure under pressure from compressed-air. This necessitated the entire structure being pressure-tight, both men and materials being moved in and out through airlocks. During construction, the working air-pressure was raised to 40 lb./sq. in. The pump house is connected to the turbine house by two 7-ft. square, reinforced-concrete underground culverts, and the circulating-water, after passing through the main condensers, is led through twin-outlet culverts to an outlet shaft and tunnel which enters the river upstream of the intake.

Contractors responsible for the superstructure and structural steelwork involved in this work were Walter Lawrence & Son Ltd., and Alexander Findlay & Co. Ltd.

respectively, whilst the chimneys were constructed by Tileman & Co. Ltd., and the precipitator casings by Bierrum & Partners Ltd. The whole of the layout of the site has been planned to allow a second station to be built downstream of the present station, on land which is at present undeveloped. This planning has determined the design of the coal-handling plant and the size of the main control room, offices and workshops.

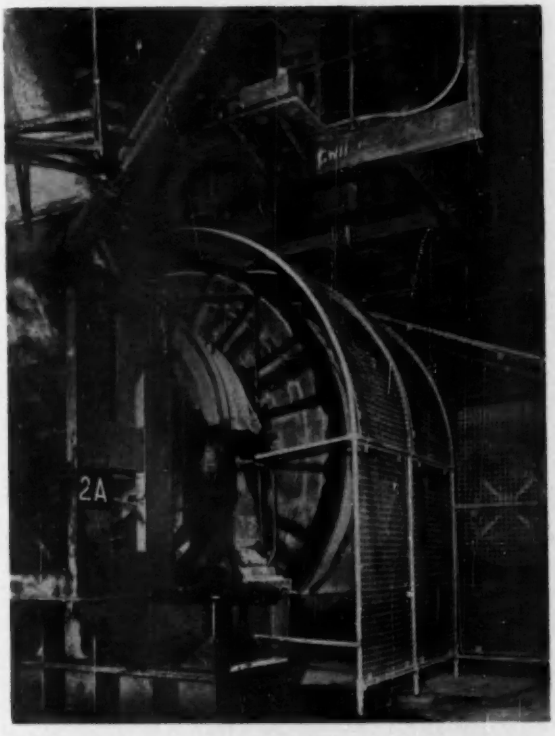
A feature of the station buildings is the provision of Lockheed hydraulic controls, which give power actuation for the opening portions of the windows and the roof lanterns from operating-floor level. The equipment, supplied by Automotive Products Co. Ltd., comprises six hydraulic systems, and separate control cabinets are installed for the operation of roof lights on the turbine house, boiler house and conveyor house. The control cabinets for the turbine house and boiler house each incorporate two six-way selector valves for their groups of twelve roof lanterns, while the conveyor house cabinet requires one six way selector only for its group of six. On each cabinet, a single edgewise-type regulating indicator is employed to show the degree of opening of each roof lantern when its appropriate selector lever is raised. Power-hydraulic operation is provided by the Lockheed equipment in all instances, and manual-hydraulic control is available as stand-by in the event of electrical power failure or other emergency. "High-duty" Autoloc cylinders of 1¾-in. bore and 10-in. stroke are used throughout, each of the thirty or more cylinders actuating the four opening portions of roof lantern by means of cross-shafts and suitable linkage.

Fuel-handling plant and equipment

The coal-handling plant to serve the station was supplied by Mitchell Engineering Ltd., and comprises four electrically-operated travelling, slewing and level-luffing jetty cranes manufactured by Stothert & Pitt Ltd. Each crane has a maximum rating of 200 tons/hr., and will deliver coal from colliers on to belt conveyors feeding the main storage area, or direct to the 730-ton capacity boiler bunkers. A travelling-transporter with a span of 175-ft. between centres of rail tracks spreads the coal deposited in the storage area, and is also used for supplying a reclaiming conveyor at rates up to 800 tons/hr.

Although originally planned as a p.f.-fired station, the boiler furnaces are at the present time being converted to oil-firing. The possibility of such a change was considered in 1955, and for this purpose two storage tanks, each with a capacity of 14,500 tons of oil (equivalent to one week's supply), have been provided, together with the necessary pipework and three oil transfer pumps, each rated at 70 ton/hr., to take oil from the 5,000-ton tankers discharging at the jetty, and deliver it at a pressure of 500 lb./sq. in. and a temperature of 280 deg. F. at the boiler oil-burners. Hot-water heaters incorporated in the storage tanks maintain the temperature of the oil at 150 deg. F. The two oil-heating and pumping units, each rated at 100 per cent. duty, provided for each boiler, together with twelve pressure-jet burners, were supplied by Hamworthy Engineering Co. Ltd. Control and lighting-up equipment was supplied by Aish & Co. Ltd.

The hot water supply to the oil storage tank heaters is provided by three auxiliary boilers, supplied by Daniel Adamson & Co. Ltd., Dukinfield, and installed in an annexe at the north-end of the main boiler house. These units are each rated at 12-million B.Th.U./hr. at 250 lb./sq. in. and 400 deg. F., and are oil-fired through two rotary oil-burners using 6,000 sec. fuel oil. They are arranged for complete automatic operation, being controlled remotely from a panel situated in one of the controls rooms in the main boiler house. Each boiler is fitted with four identical feed water controls, supplied by Ronald Trist & Co. Ltd. These are of the company's type-4A-S66/F09A, and are set at various levels and arranged to operate for high-level alarm, control of make-up pump, low-water cut-out and alarm, and low-water alarm. Three circulating pumps each rated at 400 gal./min. deliver hot water at 250 lb./sq. in. and 400 deg. F. through duplicate flow and return mains in the boiler house. These mains convey the hot water supply to the oil heaters on each of the main boilers and they also supply the storage-tank heaters and tracing for the oil pipework.



When the boilers are coal-fired, two Thompson-Kennedy pulverising mills, each of 17 tons/hr. capacity, are provided for each unit

The coal-pulverising equipment originally provided for each of the six boilers comprises two Thompson-Kennedy tube-type mills, each with a capacity of 17-tons/hr. Coal is fed into the mill by means of a plough disc-type feeder driven by an independent two-speed motor with automatic feeder control to maintain the correct level. The mills are driven by 515 b.h.p., 575 r.p.m., 3.3-kV, squirrel-cage induction motors supplied by the English Electric Co. Pulverised-fuel is withdrawn from each of the mills by three Keith Blackman Ltd. exhauster

fans, driven by English Electric 61 b.h.p., d.c. motors with automatic speed variation from 1,470 to 720 r.p.m. With coal-firing, the combined output from the two mills is fed to twelve, 12-in. Thompson-Kennedy rotary impeller burners situated in the rear wall of each boiler. The burners are provided with adjustable secondary-air registers and fuel and primary-air adjustment. A separate "light-oil" system is provided to serve the lighting-up burners incorporated in the main coal burners.

Boiler plant

The boiler plant, supplied by John Thompson Water Tube Boilers Ltd., comprises six "Etaflo" two-drum boilers, each designed for an m.c.r. of 540,000 lb./hr. at 950 lb./sq. in. and 925 deg. F., operating with a final feedwater temperature of 385 deg. F. The combustion chamber of each unit is 78-ft. high with a cross-section of 31-ft. by 20-ft., and, having an active volume of 41,500 cu. ft., is completely water-cooled by 3-in. o.d. bare tubes set at 3¼-in. pitch. The boiler is suspended from the main building steelwork; the entire furnace is free to expand vertically downwards, and is sealed at the base by dipper plates immersed in a water-filled trough. A water-wall at the rear of the boiler contains a three-stage superheater of the horizontal self-draining type having an effective heating surface of 19,050 sq. ft.—the tubes being supported by steam-cooled downcomers. Situated below the superheater section is a Thompson double-banked economiser of the plain-tube type with a total heating surface of 18,340 sq. ft. Superheated steam temperature control is achieved by the provision of automatic dampers which allow a portion of the gas to by-pass the superheater, and the main section of the economiser. Provision is also made for the recirculation of inert gas to quench the superheater elements during pressure raising. Two Howden-Ljungstrom rotary-type air-heaters, with a total surface of 234,000 sq. ft., are provided for each boiler.

The draught equipment for each unit comprises two F.D. and two I.D. fans, supplied by Davidson & Co. Ltd. The F.D. fans, which are situated at drum level, each have a capacity of 97,600 cu. ft./min. at 90 deg. F., and are driven by 200 b.h.p., 3.3-kV squirrel-cage motors with inlet control. The I.D. fans are at ground level between the precipitators and the main flue, and have a capacity of 151,200 cu. ft./min. at 244 deg. F., being driven by 388 b.h.p., 3.3-kV squirrel-cage motors through Vulcan-Sinclair, size 36 scoop-control fluid-couplings, supplied by Fluidrive Engineering Co. Ltd. Fluidrive allows an infinitely variable speed regulation of the fan, ranging in this case from 718 r.p.m. down to 150 r.p.m. All the fan motors were supplied by The English Electric Co. Ltd.

Electrically-operated sootblowers, which are automatically-controlled in sequence from the sootblower panel situated on the operating floor, were supplied by Hopkinsons Ltd. The furnace sootblowers comprise four single-nozzle retractable blowers in the furnace roof, and the superheater blowers, four single-nozzle retractable units and seven mass-element rotary type units. Steam used as the blowing medium is taken from the superheater inlet header.

To produce the correct steam conditions at the turbines after overnight shutdown, six diesel-oil-fired combustors have been fitted above the superheaters to give a superheat boost on starting-up. Provision has also been made for steam dumping by the installation of a flash-box across the main turbine condenser where the steam is desuperheated by means of condensate recirculation via the extraction pumps.

Dust-extraction equipment for the individual boilers consists of two electrostatic precipitators, supplied by Sturtevant Engineering Co. Ltd., and of that company's standard tubular type, operated by high-tension sets of the mechanical rectifier type, and interconnected on the output side in order to allow operation of either or both precipitators during periods of maintenance or overhaul. An unusual feature of this installation is that the high-tension house instead of being at ground level or intermediate level is situated on the roof of the precipitator casings, with direct bus-bar communication through to the electrodes.

Mountings and valves

The boiler mountings and valves, most of which were supplied by Dewrance & Co. Ltd., include safety valves of that company's consolidated Maxiflow full-lift type, the valve head of which is fitted with a thermodisc, to give rapid equalisation of temperature differences between the disc and seat, thus preventing distortion of the actual seating face and subsequent leakage. The superheaters are fitted with similar safety valves, but these are electrically-assisted. External high- and low-water whistle alarms are of the external-type with two-tone alarm, in which the operating mechanism is controlled by the displacement of solid discs, and under normal working conditions the system is in equilibrium. Water gauges supplied are of forged-steel construction, rack and pinion operated, and fitted with Dewrance patent bi-colour illuminated water-level indicators. The 9-in. main steam stop valves are of the internal pressure-held cover type, fitted with Dewrance-Tate electrically-operated valve equipment. Ancillary services include forged-steel valves of various types, while combined traps and strainers are fitted on the condensate lines. Some of the remaining valves, mountings, etc., were supplied by Hopkinsons Ltd., which company was also responsible for the installation of closed-circuit television equipment used for the remote indication of water-level.

Thermal insulation

The thermal insulation work, carried out by Dick's Asbestos and Insulating Co. Ltd., to the six John Thompson boilers consists of the insulation of the steam and receiver drums, superheater headers and tubes, main steam and high-pressure feed lines, pulverised-fuel and oil-firing equipment. Temperatures of the sections insulated range from 280 to 900 deg. F., and Dick's Antithermic Amosite asbestos preformed sections and also slabs have been used throughout—this material being suitable for direct application to hot face temperatures up to 1,000 deg. F. To overcome the problem of expansion on the high-temperature pipe lines, expansion joints have been fitted in the insulation at intervals of 12-ft. This has the effect of reducing expansion cracks in the insulation to a minimum when the boilers are on load. To assist maintenance and as a protection against mechanical damage, various sections of the insulation have been fitted with metal cleading, the steam and receiver

drums in blue planish steel, and pipe lines, oil-firing equipment, etc., in galvanised sheet steel, the whole of the prefabrication and erection being carried out by Dick's own staff of sheet metal workers.

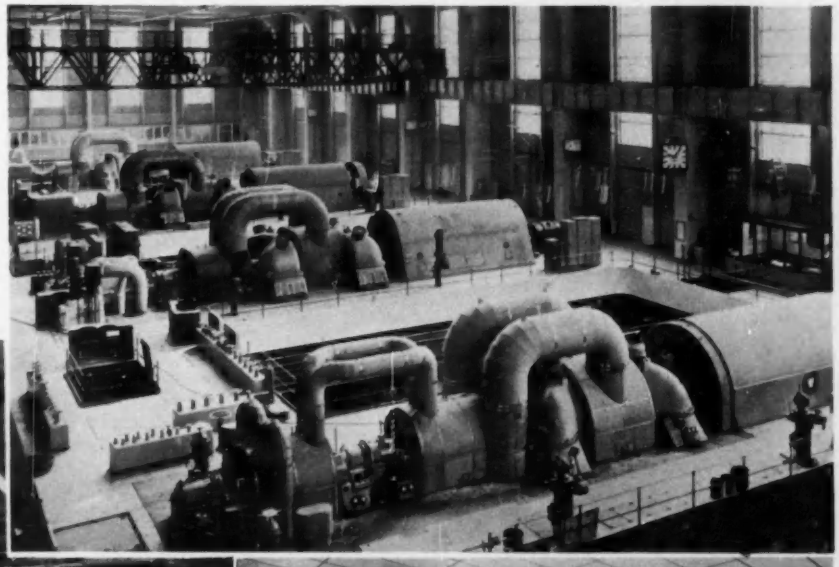
Instrumentation and control equipment

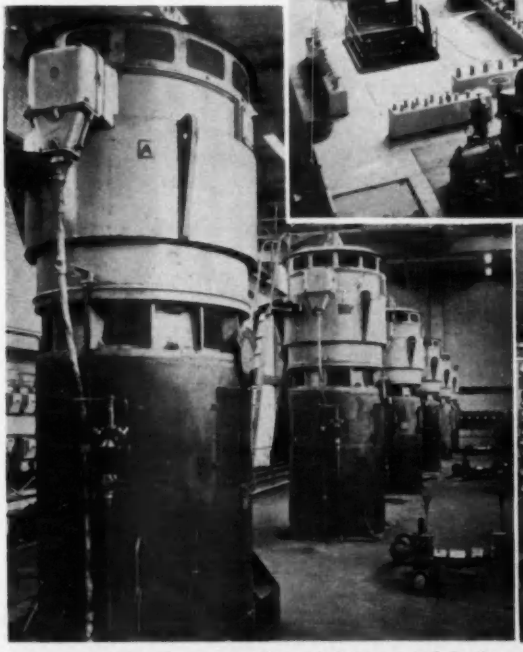
The boiler/turbine instrumentation and the automatic boiler controls were supplied by Electroflo Meters Co. Ltd. Three control rooms have been erected, each comprising two unit-operated control panels. The instrumentation is essentially miniature, and is located in its relative positions on a mimic diagram. The mimic diagram includes symbols which represent the boiler, turbine and main auxiliaries, also the paths of air, fuel, gas, oil and water systems. The Electroflo automatic boiler control provides a constant control of steam pressure, combustion rate and combustion chamber pressure. It maintains high combustion efficiency by controlling the rates of fuel and air flow in a pre-determined ratio, with automatic correction for change in fuel quality, by continuous comparison of steam evaporation with combustion air used. The desired steam pressure is maintained by controlling the fuel and air in accordance with steam load. This is accomplished by means of a master controller which is connected to the steam header and converts the changes in steam pressure which occur with variation in load into an air loading pressure for transmission to the individual regulators controlling the combustion rate. Each mill feeder is driven by a two-speed motor, and by automatically altering the driving speed, the mill level is maintained constant. This part of the scheme is designed to be entirely independent of the combustion control.

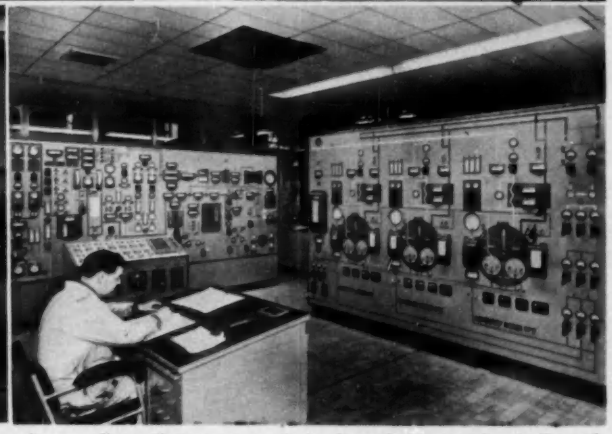
(Right). Three of the 60-MW generating sets were supplied by The English Electric Co. Ltd., and the other three by C. A. Parsons & Co. Ltd.

(Below, right). One of the air-conditioned control rooms in which the panels for two boiler/turbine sets face each other. The illustration shows also the control panel for the auxiliary boilers.

(Below). Interior of part of the circulating-water pump house.





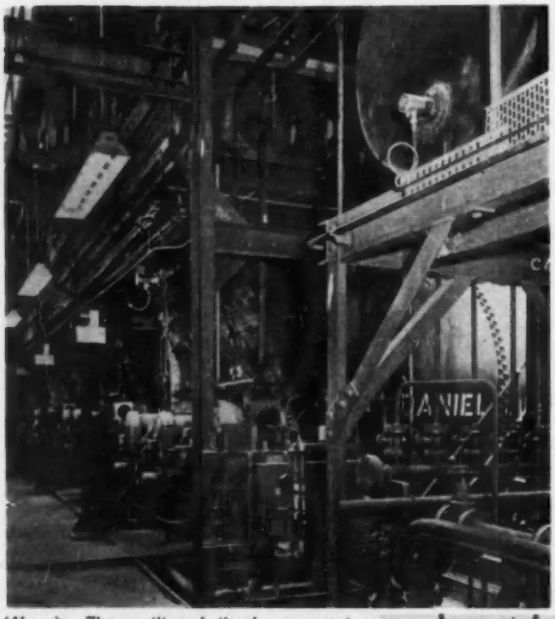


In order to control the heat input to the boiler, the primary-air to the mill is measured, and dependent on the boiler loading, the exhauster fans have their speeds altered by the shunt rheostats provided. A cam-type modulator is introduced in the exhauster regulator master loading line in order to convert the master loading pressure from a square law characteristic to that required to suit the mill requirements and also to prevent the master loading pressure falling below a pre-determined minimum. The furnace pressure is held constant by the I.D. fan regulators. Two fans are operated in parallel by two receiving regulators which are loaded from a sender relay in the measuring regulator. This regulator

measures the combustion chamber pressure, and is independent of the master controller.

Auto/manual sub panels are provided to permit the operator to transfer the boiler from automatic steam pressure control to unified manual control at the panel ; or, alternatively, individual operation of all mill and fan regulators.

Transfer to control when oil-firing is adopted is simply effected by a single changeover valve mounted inside the instrument cubicle, and control of the main oil fuel pumps can be effected from the instrument panel.



(Above). The auxiliary boiler house contains three Daniel Adamson Super-Economic type hot-water boilers each rated at 12 million B.Th.U./hr., for supplying hot water for the oil heaters and oil-fuel supply pipework. These boilers are remotely controlled from a panel in one of the control rooms.

(Right). General view in the station main electrical control room.

Steam temperature (superheat) control was also supplied by Electroflo Meters Co. Ltd. The temperature is measured by a potentiometer which supplies an electrical impulse to a temperature regulator which feeds two slave regulators. These slave regulators act on the impulse received, to maintain a constant steam temperature to the turbines, by controlling dampers in the superheat bypass duct. The controlling thermocouples for each sender regulator are connected in parallel and are located at the superheater outlets.

Ash-handling plant

The clinker and fly-ash handling plant, supplied by Babcock & Wilcox, Ltd., is designed to remove up to 45 tons/hr. of ash from the boiler ash-hopper, and for a dust extraction rate of 7 tons/hr. from the hoppers below the mechanical and electrical dust-arrestors. Ash is removed to an ashpit at the rear of the station by a high-pressure water system, comprising four 2,500 gal./min. sluicing pumps, and two 2,100 gal./min. return water pumps. Dust in the hoppers of the dust extraction equipment is removed pneumatically to 720-ton capacity bunkers outside each end of the boiler house. From the bunkers, which are provided with means for damping, the dust is discharged into road lorries for disposal.

Turbo-alternator plant

The first three of the six 60-MW turbo-alternator sets installed were supplied by The English Electric Co. Ltd., and the remainder by C. A. Parsons & Co. Ltd., with, in each case, the company concerned supplying the necessary condensing and feedheating plants. All six units are three-cylinder machines with double-flow exhaust, designed to operate at 3,000 r.p.m., with steam conditions of 900 lb./sq. in. and a temperature of 900 deg. F., at the turbine stop-valve. The first three are impulse-reaction type turbines, the remainder being of the reaction-type.

Each of the English Electric machines exhausts to a twin-shell condenser having a total cooling surface of 57,000 sq. ft., and a normal water requirement of 38,000 gal./min. Two three-stage air-ejectors and one quick-start ejector, manufactured by G. & J. Weir Ltd., are provided, the three-stage units being condensate-cooled and designed to operate at a steam pressure of 200 lb./sq. in. and a supply of 1,550 lb./hr., while the quick-start ejector takes steam from the auxiliary steam manifold at 400 lb./sq. in. The two extraction pumps associated with each condenser are two-stage, vertical-spindle units, driven by 70 b.h.p., 1,450 r.p.m. a.c. motors, and designed for a capacity of 725 gal./min. against a total head of 160-ft. Condensate is passed by either extraction pump through one air ejector, drain cooler, and l.p. heater to the de-aerator heater, from where it passes through a feed pump to three h.p. heaters and then at a temperature of 385 deg. F. to the boiler. The drains are cascaded back and pass through the drains cooler before entering the condenser. Make-up

is introduced to the system through the reserve feedwater tank. The four surface heaters are of English Electric manufacture, and the de-aerator heater was supplied by Hick Hargreaves & Co. Ltd.

The condensers associated with the Parsons machines consist of a single-shell containing two separate circulating-water circuits, and are of a similar rating to the English Electric equipment. Two Parsons three-stage air-ejectors and a quick-start ejector are provided for each turbine. The main ejectors are condensate-cooled and are supplied with 1,675 lb./hr. of steam, while the quick-start ejector is supplied from the auxiliary steam manifold at the rate of 6,500 lb./hr. Two extraction pumps are installed, each with a capacity of 775 gal./min. against a total head of 260-ft., and each driven by a 92 b.h.p. induction motor manufactured by Lancashire Dynamo & Crypto Ltd. Condensate passes through the ejector, drain-cooler, and two l.p. surface heaters, and then to a high-level de-aerator and hot-well. It is then taken to the feedpump suctions, through two h.p. heaters and then to the boiler. The drains from the surface heaters are cascaded back through the drain-coolers to the condenser. C. A. Parsons & Co. Ltd. supplied the surface heaters, and Worthington-Simpson Ltd., the high-level de-aerator and hot-well.

Cooling water is drawn from the river at a point below the coaling jetty, and first flows through six vertical rotating band screens, supplied by Wm. E. Farrer Ltd. These are each 71-in. wide and have a capacity of 2½-million gal./hr. The water is then delivered by six vertical-spindle pumps into the underground culverts from which connections are taken to each of the condensers. From the condenser outlets the water flows through outlet culverts to a discharge shaft in the river. Water from the same culverts serves various coolers throughout the station for general services including the requirements of the ash-plant. Drysdale & Co. Ltd. supplied the circulating-water pumps, each of which has a capacity of 42,000 gal./min., and is driven by 700 b.h.p., 3.3-kV squirrel-cage motors at a speed of 485 r.p.m. A chlorinating plant supplied by United Filter & Engineering Ltd. is provided to introduce chlorine into the circulating-water at points adjacent to the inlets of the condensers.

Each boiler is served by three feedpumps. These were supplied by Sulzer Bros. (London) Ltd., and are 11-stage units, driven by Metropolitan-Vickers 700 b.h.p. motors at a speed of 2,950 r.p.m. Each pump has an output of 536 gal./min. at a discharge pressure of 1,208 lb./sq. in., and handles feedwater at a temperature of 240-270 deg. F. All these units are fitted with leak-off equipment, some being provided with the non-differential-type and the remainder with the differential-type.

The high-pressure pipework was supplied by John Thompson Ltd., and the low-pressure piping associated with both boilers and turbines by Stewarts and Lloyds Ltd., together with supply and erection of the necessary valves and lagging.

Two separate water-treatment plants supplied by The Permutit Co. Ltd. have been installed. In the first, water from the salt-water evaporators which are treating Thames Estuary water is passed through two mixed-bed units to the station condensate system. In the second, water from the town supply is treated by means of an automatic Hi/Na blend plant before being used for evaporator feed. Each mixed-bed unit is designed to treat 4,600 gal./hr. of hot distillate from the salt-water evaporators at a temperature of 140 deg. F. The water handled has a very low total dissolved solids content, and electrical conductivity of less than 0.1 reciprocal megohm per centimetre cube, and a silica content of less than 0.2 p.p.m. Each unit contains an intimate mixture of Permutit cation and high basic anion exchange materials, and when the exchange capacity of the units is exhausted, the two materials are separated by upward washing and are regenerated separately. The Hi/Na blend plant has been designed to produce 5,000 gal./hr. of treated water, and consists of a Zeo-Karb HI unit and regenerating equipment, a Zeo-Karb Na unit and regenerating equipment, and a degasser and caustic soda dosing gear. Raw water is passed to the Zeo-Karb HI unit which contains cation exchange materials and works on the hydrogen cycle so that mineral salts in the raw water are converted to their corresponding acids and bicarbonates are decomposed to form carbon dioxide and water. In a similar way the Zeo-Karb Na unit is fed with raw water and the calcium and magnesium salts formed are converted to their sodium equivalents. Water treated by the two units is then blended so that the acids in HI treated water results in liberation of carbon dioxide and a residual alkalinity dependent on the proportion of base-exchange treated water. Free carbon dioxide is removed by allowing the blended water to fall under gravity through a counter-current of air in the degasser tower and the degassed water is dosed with caustic soda to correct the pH.

The first two machines in the station are equipped with dual-purpose triple-effect evaporating plant manufactured by Aiton & Co. Ltd., each with an output capacity of 21,000 lb./hr., while on the remaining four sets Aitons have supplied two double-effect low-pressure salt-water evaporators, each with an output of 10,500 lb./hr.

The alternators generate at 11.8-kV, and the output is fed directly into a transformer and raised to 132-kV. The generators are enclosed in pressure-type casings and arranged for hydrogen-cooling, the hydrogen being circulated at a pressure of 0.5 lb./sq. in., and cooled in distilled-water coolers. No. 6 generator is of particular interest as the stator is cooled by distilled-water which is circulated through the windings. This is a prototype installation for the purpose of obtaining experience in the water-cooling of stators before applying the method to generators being manufactured for the C.E.G.B.

Opening ceremony

Some 900 guests were present at the opening ceremony when Mr. W. N. C. Clinch, M.I.E.E., controller, Eastern Division, C.E.G.B., introduced Col. Sir Francis Whitmore, Bt., K.C.B., C.M.G., J.P., H.M. Lieutenant of the County of Essex, who unveiled a plaque to commemorate the occasion of the formal opening of the station. Sir Francis said that he had had the opportunity of inspecting the station and was intrigued by the multiplicity of intricate equipment and the technicalities involved in present day methods of electricity generation. Mr. Clinch expressed appreciation of the efforts of the main and sub-contractors who had been responsible for the construction of the station, and referred to various difficult problems which had been encountered and overcome during the period of construction. Mr. A. R. Cooper, M Eng, M.I.E.E., M.Inst.F., regional director, presented a small plaque to Sir Francis Whitmore.

Peaceful Uses of Atomic Energy in Australia

AUSTRALIA has not, as yet, decided upon her policy with regard to nuclear power development. Although deposits of uranium ore are being exploited in Queensland and South Australia, the incentive to establish one or more atomic power stations is not so strong as in the United Kingdom. At an Atomic Energy Symposium held in Sydney last month, British and Australian nuclear scientists urged the desirability of an early start with plans for a 100-MW atomic power plant in South Australia. This project would, it was suggested, enable the Commonwealth to train personnel in the operation of nuclear reactors, with an eye to the 1970s when it was likely that there would be greater reliance upon atomic power. The projected station would come into operation in 1963 or 1964 if the plans were laid now, and it would be a valuable source of fissionable material for use in later and improved designs of reactor. Some representatives of the Australian electricity supply industry, however, remained unconvinced that atomic power generated in plants of the size appropriate to the sparsely populated character of South Australia could compete with modern coal-fired plant burning local coal which can currently be supplied at an incremental cost of £A1 7s. per ton. There was general agreement on the need for engineers from Australia to study nuclear power developments overseas, and a representative of the United Kingdom Atomic Energy Authority promised the help of his organisation should Australia decide to enter the nuclear field.

The Symposium was held at the University of Sydney from June 2nd to 6th, 1958, under the auspices of the Australian Atomic Energy Commission. It was attended by more than 400 scientists and engineers, some 40 of whom were from overseas. They included representatives of the United Kingdom, France, Canada, New Zealand, Pakistan, the United Nations International Atomic Energy Agency, and the U.S.A. Of the 110 papers presented, 89 were by Australian authors. They dealt with many aspects of atomic energy, including raw materials, power generation, education, and the industrial and medical uses of radioactive isotopes.

Prof. J. P. Baxter, Chairman of the Symposium Committee and of the Australian Atomic Energy Commission, presided at the first session, when Senator W. H. Spooner, Federal Minister for National Development, gave the opening address. He recalled the resolution passed by the United Nations in December, 1954, urging all nations to co-operate in developing the use of atomic energy to lift the burdens of hunger, poverty, and disease from mankind. Australia now had its own research reactor, HIFAR, which, appropriately, went critical on Australia Day (January 26th) this year and was now being worked towards full power. HIFAR formed part of the equipment of the Commission's new research establishment at Lucas Heights, in which Australia had invested £A6 million, a substantial appropriation for a country with a population of less than 10 million.

United Kingdom programme

Mr. H. H. Gott, of the United Kingdom Atomic Energy Authority, said that since Calder Hall was completed there had been engineering developments which had posed new technical problems. The size of the latest reactors was greater, and there were two to three times as many fuel elements ; one result had been to introduce new and as yet unsolved problems in reactor control. The fuel in these reactors operates at a higher temperature than at Calder Hall and for a longer time, but apprehensions about the effects of irradiation creep on the ability of the fuel to retain its shape had proved unjustified and independent support of the individual elements was not now felt to be so vital.

The reactor power stations under construction in the United Kingdom are estimated to produce power at about the cost with coal-fired stations, and a change in the type of reactor would not be justified unless : (i) The new reactor can *with considerable certainty* generate at a lower cost than those now under construction. (ii) The generating system as a whole dictates a change, because of load factor or other considerations. (iii) The " nuclear system " dictates it, perhaps by the need to burn plutonium. Summing up, we are probably at the stage when a 5 or 10 per cent. improvement in generation costs achieved at small capital risk is to be preferred to a 20 or 30 per cent. improvement involving high capital risk.

In the verbal presentation of his paper, Mr. Gott said that the fuel elements in the U.K. reactors were giving an *average* burn-up of 3,000 MWD/ton, and it was hoped to improve upon that figure. Each fuel element was left in the reactor as long as possible, consistent with the requirements that it must not suffer so much distortion that it becomes difficult to extract, and that penetration of the fuel can and consequent release of fission products into the cooling stream must be avoided. The U.K. Atomic Energy Authority charges the Central Electricity Generating Board £20,000 a ton for the uranium in the fuel, and buys spent fuel back for about £5,000 a ton. The credit for the spent fuel is arranged on a sliding scale so as to give the Board an incentive to secure the maximum practicable burn-up.

Possible developments in nuclear fuel cycles in Australia

Prof. J. P. Baxter and Mr. C. N. Watson-Munro, of the Atomic Energy Commission, forecast the requirements of fissile and fertile material by the Commonwealth up to the end of the century. They considered that by the year 2000 an installed generating capacity of

35,000-MW would be required, and that 20,000-MW of this would be supplied from nuclear sources. The reactor systems installed will probably consist of a combination of fast breeders (conversion factor 1·4) and thermal breeders with conversion factors of 1.1 and 0.9, for which about 5 tonnes of fissile material would be required. This would be provided by manufacture of plutonium in Australia by means of natural uranium reactors. To produce 5 tonnes of plutonium by the year 2000, it would be necessary to provide about 1,000-MW (electrical) capacity of natural uranium reactors between 1965 and 1975, for which about 2,500 tonnes of uranium would be needed. The amount of fertile material burnt would be negligible in comparison with the "capital" requirements. The plutonium would either be recycled with home-produced or imported natural uranium, or would be used in a fast reactor.

The discussion on this paper emphasised the importance to posterity of making full use of breeder reactors to eke out the world's supplies of uranium fuel. In particular, Mr. L. H. Roddis (United States Atomic Energy Commission) recalled that man's prodigality had changed the once-fertile lands of Carthage and Assyria into the deserts of North Africa and the Middle East. Though some scientists believed that harnessing the thermonuclear reaction would in 20 years' time make uranium unnecessary, he personally did not think so.

Atomic power in Australia—economic considerations

A paper by a group of experts representing the Commonwealth Bank stated that, of the 3,800-MW of installed generating capacity in Australia in 1955-56, 78 per cent. was steam plant, 17 per cent. hydro, and 5 per cent. of the internal combustion type. The units generated by the three types were in roughly these proportions.

The capital cost of a large modern coal-fired station would be £A80 per kW, and the running charge 0.6d. per kWh. A nuclear power station of the Calder Hall type would cost £A160 per kW to build and 0.8d. per kWh to operate. Thus, for coal-fired stations the capital cost would be about half and the running cost about three-quarters of those for nuclear stations. By 1975, nuclear stations might be competitive with coal-fired steam stations, though the former would be of higher capital cost. However, with an eye to the future, a decision would have to be taken from about 1975 on replacing coal-fired stations by nuclear stations.

In taking this decision three possibilities would have to be considered : (1) An isolated decision to change over to nuclear power before 1975 by one or more remote towns or industrial plants currently using high-cost conventional power. (2) A decision to make a limited change-over, by a single electricity authority facing high conventional fuel costs in expanding its generating capacity. (3) A general decision by the main electricity supply authorities to change over about 1975.

An example of (1) is the mining town of Mt. Isa, in Northern Queensland, where power generation costs are 2d. per kWh on account of the high cost of transporting coal 700 miles from the nearest colliery. A change from coal to uranium at Mt. Isa would have little effect on the Australian coal industry, because the requirement is only 70,000 tons of coal a year, but it would involve an increased charge on the balance of payments, because of a higher foreign exchange component of capital costs and because the uranium fuel would have to be imported. Plants could, of course, be set up to process fuel for natural uranium reactors from indigenous uranium ore, and to reprocess the spent fuel, but the construction of these plants would not be economic except on a much larger scale. It would therefore seem necessary to buy the fuel overseas and return spent fuel for reprocessing, undesirable though this would be strategically. Substantially the same considerations would have to be taken into account should alternative (2), i.e. a limited change-over by, say, the State of South Australia, be contemplated ; though the main economic effects would clearly be more important in this case than in (1).

With regard to (3), it would be desirable to give consideration to the following three factors before deciding to make a general change-over : First, Australia's coal resources are adequate to meet electricity generation requirements well beyond the year 2000 ; and it is not certain that local uranium resources would sustain power requirements much beyond that period. Secondly, bearing in mind the possibility of developing other uses for coal, e.g. as a source of industrial chemicals, and the social implications of redundancy in the coal industry, it would be in the national interest to consider the optimum usage of coal and uranium together. Thirdly, base-load generation costs are only one element in power costs. Distribution costs are also important, and therefore a small margin of cost advantage in favour of nuclear power generation might not warrant an immediate change-over. It is concluded that although the technical possibilities more than justify present Australian research and training programmes, on economic grounds the case for the early adoption of nuclear power in Australia is not strong.

In the discussion, emphasis was laid on the need for an early start with building up a stock of fissionable material, even if there was no intention to change over from coal to nuclear power within the next few years. The decision which a supply authority might have to take on replacement of worn-out generating plant by modern coal-fired equipment now, or alternatively nuclear plant in several years' time, was not easy. The fuel cost with a nuclear station was low, and would probably fall in years to come. The future cost of coal, however, was bound to rise as the best seams were worked out, and poorer coal had to be mined to meet an ever-rising demand. One speaker prophesied that in 25 years' time the cost of nuclear power would be very much less than of coal power. Also, as new areas remote from the coalfields were opened up, it would prove advantageous to have small nuclear plants rather than go to the expense of long-distance transmission of electricity from coalfield pit-head stations.

Gas-cooled graphite-moderated reactors for Australia

Mr. A. L. Shaw, of A.E.I.-John Thompson Nuclear Energy Co. Ltd., drew a comparison between the requirements of Northern Ireland and of South Australia in regard to the provision of a nuclear power station at the present time. Northern Ireland, with an independent electricity supply network and a power concentration of only 400-MW, is actively considering the installation of a 150-MW output gas-cooled graphite-moderated reactor

station. Such a station would be economically and technically practicable for Australia at the present time. Its capital cost would be in the region of £A180 per kW installed, and at an interest rate of 5 per cent. the unit-sent-out cost would be about 0.8d.A. If a preliminary inquiry for such a station were made now from Australia to the British nuclear power industry a tender could be put forward in about 12 months' time and if this were accepted without undue delay, the station would be commissioned in 1963 or 1964. To ease her balance-of-payments problem, Australia could, if she wished, undertake the manufacture and erection of a large proportion of the components, to a total value of £A11 million out of a total cost which might be £A25 million. The economic practicability of such a station would, of course, depend on the degree to which coal- or oil-fired competing stations would be penalised by fuel transportation costs.

British experience shows that the categories of staff suitable for a conventional station are quite suitable for the operation of a nuclear station, provided that certain of the staff are given suitable "conversion" courses overseas, including experience of operating nuclear plant in Great Britain.

Mr. Shaw said in answer to questions that beryllium cans for fuel elements would probably be adopted in reactors commissioned after 1965. As regards burnup at the design figure of 3,000 MWD/ton it would be possible to achieve 100 per cent. load factor, but in practice, 90-95 per cent. would be more usual, allowing for the time out of commission for annual inspection.

The future of nuclear fuel reprocessing in Australia

Dr. G. L. Miles, of the Australian Atomic Energy Commission, discussed fuel processing requirements of various types of power reactors. The research effort on this aspect of nuclear science would comprise, first, laboratory and pilot-plant studies of the feasibility of processing particular reactor fuels; and secondly, arrangements to process and recover the fuel from prototype reactor experiments. The fuel for the HIFAR research reactor is being supplied by the U.K.A.E.A. and will be returned to Dounreay for processing. It may, however, prove necessary to make arrangements for local processing of the fuel from HIFAR and from the other research reactors to be constructed in Australia before 1975. The most urgent requirement will be probably for low-power reactors of the swimming-pool type.

After discussing the present status of the various separation processes Dr. Miles considered problems of treatment and disposal of radioactive effluents, giving estimates of the arisings of long-lived fission-product effluents in 1965, 1970, and 1975 (cumulative 3×10^7 Curies by 1975). It should be feasible to provide for safe storage of all these effluent in underground tanks, on a semi-permanent basis. The large volumes of intermediate activity containing tens or hundreds of Curies of fission products would present a more difficult problem. The only two practicable methods are (a) ground disposal in desert areas; (b) sea disposal. Steps will first have to be taken to drop the fission product concentration to a level such that disposal is practicable. An estimate is made of the capital investment in fuel reprocessing plant in Australia in the next two decades. Total expenditure on fuel reprocessing is expected to reach £A25 million by 1975.

Gas turbines for nuclear power plants

A paper by Prof. G. G. McDonald, of the University of Sydney, on the thermodynamics of the gas-turbine engine is of interest in relation to the design of the projected G.E.C.-Simon-Carves station at Hunterston. He showed how the performance (expressed in terms of gas flow per second, number of stages, turbine power, stage efficiency ratio, and overall thermal efficiency) of a closed-cycle gas turbine using helium, carbon-dioxide, or air can be expressed in terms of the performance with nitrogen. Carbon dioxide seems to be the best of the three gases from the point of view of turbine performance at the assumed inlet pressure of 750 lb./sq. in. and temperature 750 deg. C.

Simple ideas of heat transfer are applied to the heater or reactor core of a nuclear power plant, assuming the total-heat quantity and the temperature-differences are kept constant while the gas and the size of the core are varied. The weight flow per second, heating surface, pressure drop, and specific pumping power for helium and carbon-dioxide are compared with those for nitrogen. The comparison confirms that carbon-dioxide is a feasible charging gas for this type of gas turbine system, though not as good as helium. Similar comparisons could be made between nitrogen and other gases such as hydrogen and argon which have been suggested as charging gases for nuclear gas turbines.

Interaction between nuclear power reactors and turbo-alternators under dynamic conditions

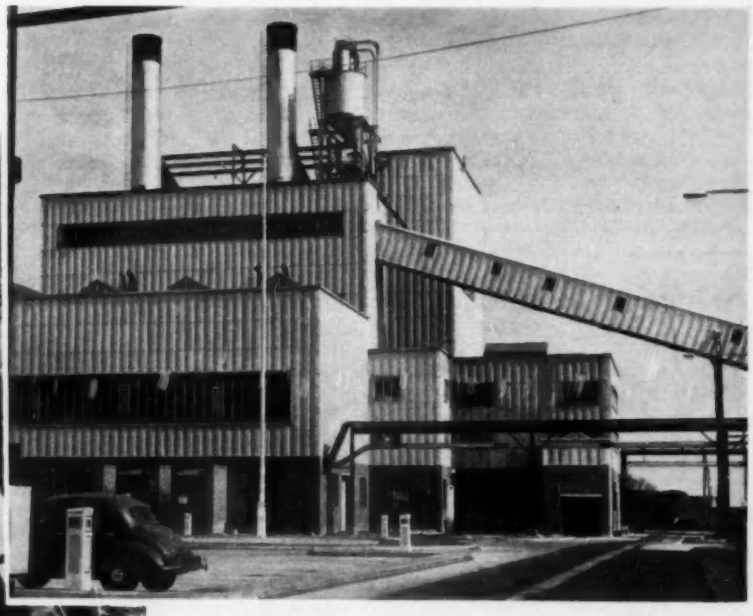
In a paper with the above title, Dr. H. K. Messerle and Mr. J. F. Armstrong, of the University of Sydney, pointed out that in a nuclear power plant the negative temperature coefficient of reactivity of the reactor inherently assists in the regulation of heat flow from the source. Thus, if the turbine load is decreased, steam temperature will rise, followed by rise in the average temperature of the reactor and consequent decrease in its reactivity, which decreases the thermal output until the relatively slow-acting reactor control system takes over. The aim should be to relate the reactor output to the thermal changes produced by disturbances at the turbine.

The effect of steam-raising plant on the dynamic stability of turbo-alternators was investigated mathematically, and it was shown that the stability can be modified considerably if nuclear reactors are used as heat source and the heat-storage capacity of the heat exchangers in the nuclear plant is small. The investigation was based on the assumptions that external reactor controls are slow-acting and that fuel poisoning is a slow process. These assumptions are valid if the turbo-alternators have speed governors, but not when frequency and tie-line power control has to be considered.

Mr. W. Sampson, M.I.Mech.E., M.I.Mar.E., has retired as manager of the Steam Division of Foster Wheeler Ltd., but remains a director of the company. He has been succeeded as manager of the Steam Division by **Mr. C. E. H. Verity,** O.B.E., M.I.Mech.E., M.I.E.E., M.I.Mar.E., who is also a director of the company. **Mr. R. L. J. Haydn,** B.Sc., A.C.G.I., continues as assistant manager of the Steam Division, **Mr. L. K. D. Wood,** M.B.E., M.I.Mar.E., has been appointed marine manager and **Mr. L. J. Culver,** B.Sc., A.C.G.I., A.M.I.Mech.E., A.M.I.Mar.E., at present head of marine boiler design, becomes assistant marine manager.

(*Right*). *The west front of the power house.*

(*Below*). *An overall view of the new North Board Mill and Power House at Thatcham.*



New Board Mill at Thatcham

ON a forty-acre site at Thatcham, near Newbury, in Berkshire, a paper board mill has been completed recently for Colthrop Board and Paper Mills Ltd. —a member company of the Reed Paper Group. The new mill, which is a £5 million project and represents Britain's first complete mill for twenty-five years, is entirely self-contained with, in addition to the main production plant, its own power station, maintenance workshops, raw-materials building, finishing department and water-treatment plant.

The site is situated to the north of the original Colthrop Mills (where, incidentally, there has been a paper mill for well over two centuries), and alongside the Western Region main railway line from Paddington-Exeter-Plymouth.

The site, which is low-lying and tended to be water-logged at times, presented difficulties in construction of the various buildings, especially where heavy loadings had to be taken, and any possibility of settlement guarded against. Considerable care had also to be taken in carrying out foundation works in view of the close proximity of the main line railway. It was, therefore, decided to adopt piled foundations of the bored type, cast *in situ*, with borings for the piles of an average depth of 22-ft. Approximately 2,400 piles were used.

An area of 183,610-sq. ft. is covered by the main buildings, which have a length of 1,085-ft. In planning the lay-out of the buildings allowance was made for the possibility of a further mill being required in the future. This would be a duplicate of the present mill, with its own raw materials, preparation plant and other buildings. Full provision in foundations, structural connections, roadways, drainage facilities, etc., has thus been made for these possible extensions. Reinforced-concrete construction was used, in general, for the buildings. Where acid conditions were likely to be encountered during manufacturing processes, sulphate-resisting cement was used in the construction of the buildings in question, and these buildings are all separated from each other by expansion joints which form 2-in. gaps extending through the structure from top to bottom.

The raw materials building, 305-ft. long by 192-ft. wide by 58-ft. high, is divided into three bays, each enclosed by reinforced-concrete walls which act both as retaining walls, and as fire breaks to minimise the spread of fire between one bay and the next. Each bay is surmounted by a steel portal framed roof. Cross-reinforced-concrete walls subdivide each bay into cells. Across the end of the bays is the " hydrapulper " area, and this abuts on to the three-storey preparation plant building from which it is separated by a fire-proof wall.

The latter building is 180-ft. long by 110-ft. wide by an overall height of 64-ft., and has a roof of reinforced-concrete slab with asphalt roofing laid on cork insulation. It houses the main preparation plant, refiners, screens and thickeners, and a china-clay and alum store.

The machine house is divided into three sections, namely, the screens area, machine house proper, and the drive annex. The machine house has two expansion joints in its length of 435-ft., and has a width of 75-ft., including the annex which has intermediate floors, the upper storey accommodating the ventilation plant for the board-making machine, and the first floor, the drive equipment.

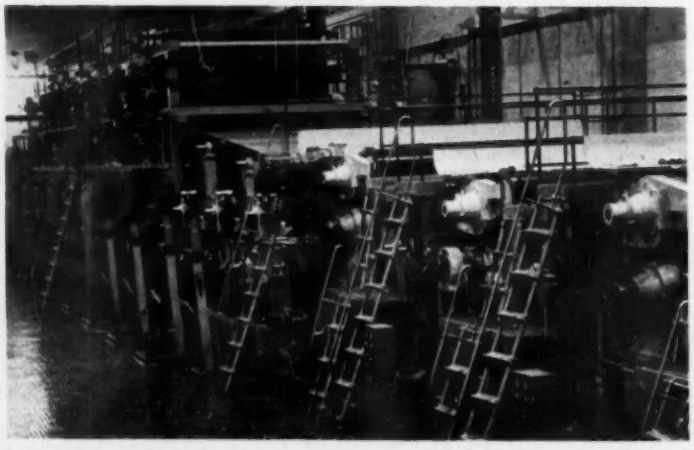
In view of the exceptionally wet and humid conditions, special consideration had to be given to the design of the building structure to avoid damage to the structure by corrosion or condensation. The flat slab ceiling is carried by cambered reinforced concrete beams, except in the way of the stack dryer, where the ceiling is of heated enamelled steel plates. Granolithic flooring is general but at the wet end of the board-making machine there are red brick paviours laid on acid-resisting asphalt.

Mill machinery

It will be appreciated that in such a modern and well-equipped mill, a very extensive range of machinery and associated auxiliary equipment is provided. Space limitations prevent us from describing this machinery, but there are many interesting features of the new board machine itself to which reference should be made.

The board machine, which has an overall length of 325-ft., is designed for a trimmed width of 110-in. and a maximum speed of 600-ft./min. It incorporates in its design many details developed by the company's engineering department, and was built by Walmsleys (Bury) Ltd. and their associates Walker Bros. (Wigan) Ltd. Four main types of board are produced in the new North Board Mill ;—white-lined manilla, white-lined chip, cream-lined chip and kraft-lined chip. The board is sent to all parts of the country for conversion into folding cartons of every shape and size, to be used by almost every industry in Britain. The new machine, which makes mainly folding box board, will double the output of board at Thatcham.

On the new machine all four stocks are delivered to separate compartments in a stainless-steel headbox sited above eight dual-drive bird screens, through which they pass at a controlled rate. From these screens diluted stock is discharged through stainless-steel outlet boxes to conical mixing boxes for de-aeration and further mixing with white water.



The wet end of the new board machine which is 325-ft. long and produces box board 110 in. wide, at a maximum speed of 600 ft./min.

The stock finally flows from the conical mixing boxes to the machine vat section through stainless-steel or mild-steel " Lithcote " lined piping into stainless-steel flow spreaders connected to the first up-flow passage of each vat. The vat section comprises eight 48-in. diam. cylinder moulds and vats—six of the contraflow type, and two so designed that they can be used for contraflow or uniflow operation. Four of the cylinder moulds are driven, and the remainder are prepared to receive drives.

Following the vat section there is a 28-in. diam. extractor roll and then a 30¼-in. diam. suction return roll leading to five primary presses mounted on fabricated steel box section frames located immediately above the vats. In the fourth primary press position there is a suction press ; but all five positions are so designed with cavity framing that a suction press can be mounted in any one of these.

The main press section comprises a first plain press, a second suction press and then a third plain press, all having 26-in. diam. rolls with granite top rolls in each position.

Drying sections

The pre-dryer section comprises twenty-six 5-ft. diam. steam-heated drying cylinders arranged horizontally in two tiers, with a Ross-Grewin vapour absorption system. The whole section is covered by a dryer hood with extraction fans discharging to exhaust towers rising above the main roof level. There are 130 steam-heated drying cylinders each 3-ft. 6-in. diam. in the main dryer section, arranged in eight vertical stacks. A standard cross-tube type of vapour absorption system using fairly high-velocity hot air is installed on the stack dryers. A steam-heated smoothing press having 24-in. diam. chilled iron rolls is located between the second and third vertical stacks.

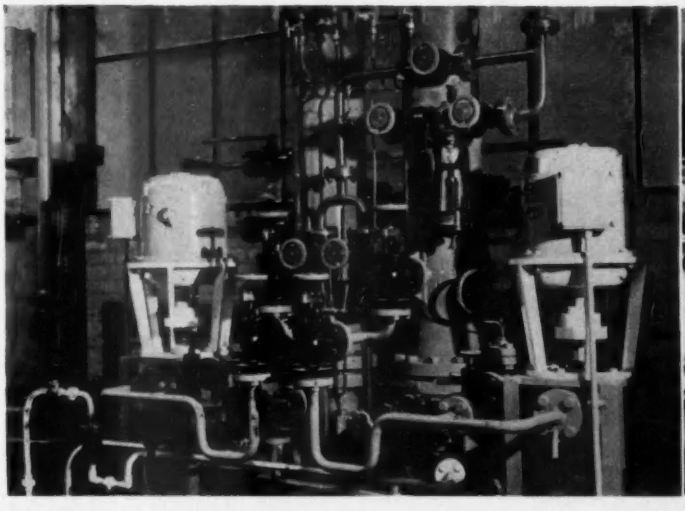
Two seven-roll finishing calenders are installed, all are fitted with Vickery doctors, and five rolls in the first stack have water doctors to give the material a good gloss. The double-arm drum pattern reel-up machine winds reels up to 76 in. diam.

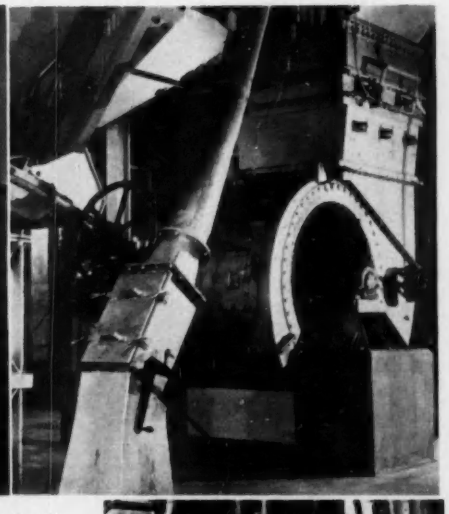
The machine is driven by a Harland interlocked sectional electric drive having an operating speed range of 100 to 600-ft./min. with a crawl speed of about 30-ft./min. There are twenty-five separate driving units, each comprising a motor and gearbox on a combination bedplate and ranging from 5 h.p. to 80 h.p. The driving shafts are all fitted with flexible couplings and connect to the machine through special openings in the annexe wall. A 775 h.p. synchronous induction motor drives the main 500-kW generator, and a flat-back open-type circuit-breaker switchboard supplies the section drive motors.

Baldwin " Atomat " radiation gauges, installed at two points, continuously check the board substance on the machine, and recording instruments indicate any change

in weight so that immediate adjustments can be made. At the end of the machine is a Masson slitter and rewinder having a Hackbridge & Hewittic "Velotrol" type grid-controlled mercury-arc rectifier supplying a variable-speed Mather & Platt d.c. motor, giving an operating speed range of 200-ft. to 1,600-ft. per min. Below the winder at ground-floor level, there is a broke beater supplied by West End Engine Works Ltd., and driven by a 150 h.p. Mather & Platt motor. This beater is situated in line with the machine and can deal with all "broke" which arises, including the trim from the winder above. Reels are finally transferred from the machine or the winder by means of a special motor driven trolley on to a balcony projecting into the salle building whence they are handled by an overhead travelling crane.

In a process as precise and complex as the manufacture of high-grade board, accurate automatic control is essential :— moisture, oil, and dirt, in the compressed-air supply lines would severely affect the delicate instruments. The accuracy of the air-operated control instruments at the mill is guarded by three Birlec adsorption dryers and ancillary filter equipment. The dryers are of the dual-adsorber type, each capable of handling flows of 50 scfm at a pressure of 150 lb./sq. in. The outlet dewpoint is — 15 deg. C. at a temperature of 80 deg. F. Using

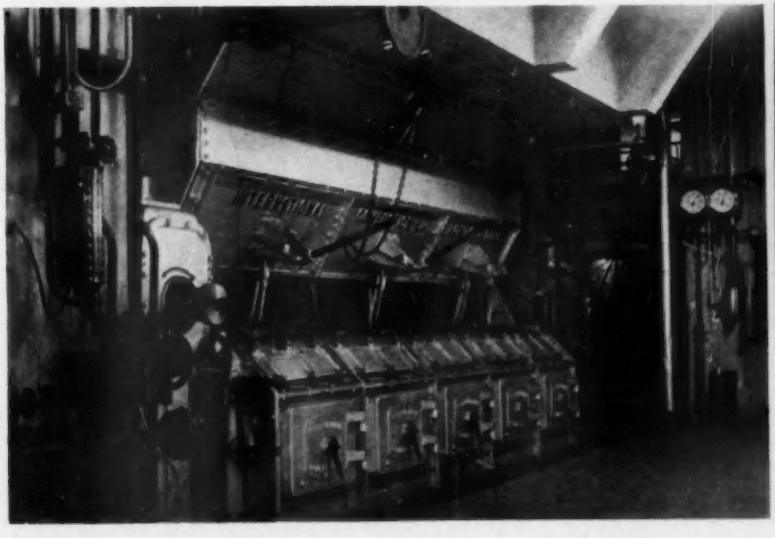


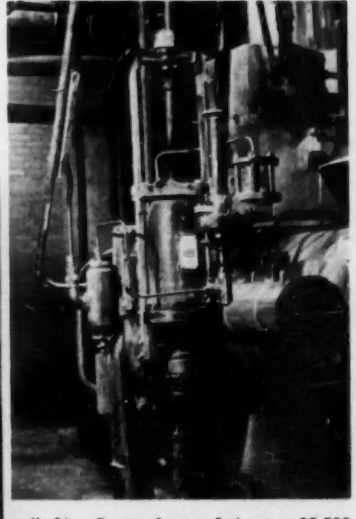


(Above). *Fuel-oil heating and pumping units in the boiler house at the new board mill.*

(Above right). *Howden forced-draught fan, and ash-hopper serving one of the boiler units.*

(Right). *A desuperheater control unit supplied by James Gordon & Co. Ltd. for the boiler plant.*





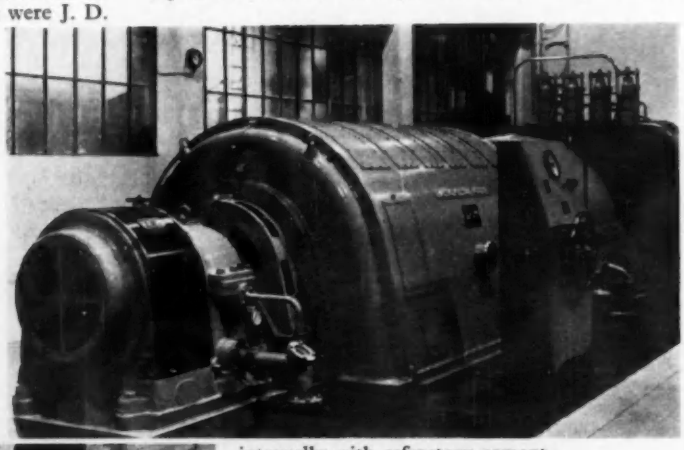
(Left). Front of one of the two 88,500 lb./hr. stoker-fired boiler units which were supplied by International Combustion Ltd. The L-type stokers are designed to burn bituminous coal or coke-breeze, ignition of which is effected at lighting-up by means of oil-burners fitted one at each side of the boiler, and firing through the side walls of the furnace.

activated alumina, the units are fully automatic ; electric heaters are embedded in the alumina for reactivation. The steam circulating and condensate system was supplied by Reiss Engineering Co. Ltd.

Power station

The power station building shown in our illustration at the head of this article is separate from the mill, covers an area of 12,000 sq. ft., and is divided into sections comprising boiler house, turbine-house and water treatment plant annex. The engineering consultants for the design and construction of the power station were J. D. Crozier and Partners Ltd.

The steam generating plant comprises two 88,500 lb./hr. water-tube boilers supplied by International Combustion Ltd. The boilers are of the three-drum vertical tube type, with integral steam receiver between the boiler drum and the superheater inlet. The working pressure is 525 lb./sq. in. and the superheater outlet temperature 780 deg. F. The superheaters are of the Superheater Company's MeLeSco type with pendant elements, having forged steel ends and ball



(Right). The 7,500-kW turbo-alternator set supplied by Metropolitan-Vickers Electrical Co. Ltd. (Below). The steam-driven boiler feed pumps were made by G. & J. Weir Ltd.

joint connections to the solid-drawn steel headers supported on the boiler structure above the top drum level. The economisers, supplied by Senior Economisers Ltd., are arranged in three tube banks for gas flow upwards, but with water flow downwards in the two top banks and upwards in the bottom bank. The inlet water temperature to the economiser is 200 deg. F. and at maximum boiler load, this temperature is raised to 364 deg. F. with an exit gas temperature reduced to 330 deg. F. Steam-operated traversing type soot-blower equipment supplied by Ivor Power Specialty Co. is installed. The water outlet from the economiser is directly connected to the rear top drum of the boiler. Each boiler is equipped with separate forced-draught, secondary-air and induced-draught fans supplied by James Howden & Co. Ltd. The forced-draught and secondary-air fans are installed at ground-level inside the boiler house, but the induced-draught fans are installed outside the building on the boiler house roof. A Howden Multi-Vortex type grit-arrester is installed on the suction side of each induced-draught fan, discharging to individual self-supporting steel chimneys. Each chimney is 7-ft. diam. and the top is 120-ft. 6-in. above ground level ; they are lined internally with refractory cement.

Each boiler has a single stoker of the International Combustion "L" type 16-ft. 6-in. wide and 22-ft. long, and provided with a motor-driven eight-speed totally-enclosed oil-lubricated gear drive. The stokers are designed to burn bituminous coal or coke breeze, and incorporate special construction of the front compartment of the under-grate wind box, together with high pressure air-ejectors to maintain satisfactory burning of the low volatile coke breeze ; ignition of which is effected at lighting-up by means of oil-burners fitted one at each side of the boiler through the side walls of the furnace, close to the front ignition arch.

The oil-burners together with the pumping and heating unit are of Associated British Combustion Ltd. manufacture. The burners are of the pressure atomising type, with air supply from a secondary air fan located in the basement. An oil fuel bulk storage tank is located outside the boiler house and the oil is heated by an electrical heater, thermostatically controlled, and is pumped to a ready-use tank inside the boiler house above the main pumping, heating and control equipment located at firing-floor level between boilers.

The furnace front and side walls are water-cooled, and suspended refractory front and rear arches of the Ivor type are provided. The coke-breeze is delivered by railway wagons which are handled by a Strachan & Henshaw "Rotaside" wagon tippler and discharged into an underground hopper, the outlets of which discharge on to inclined belt conveyors which deliver it to two suspended bunkers, each of 250 tons capacity. The daily intake of fuel is 250 tons, and provision is made for

ground-level storage with a capacity of 10,000 tons.

When burning coke-breeze fuel containing a high percentage of fines, the discharge from the grit-arresters and dust-hoppers at the rear pass of the boiler is fairly heavy and has approximately 70 per cent. combustible matter. To conserve this, the grits are collected by a pneumatic system and delivered to a 15-ton capacity bunker at roof level from which they are periodically discharged to mix with fuel on the incoming conveyor to the overhead bunkers and are re-fired.

Ash removal plant

A hydraulic ash-collecting system of International Combustion Ltd. manufacture has been installed. Ash from the stoker hoppers falls into a sluice in the boiler house basement floor, along which there is a continuous stream of water travelling at a high velocity. This carries the ash into a swirl pit from where it is pumped by duplicate ash pumps into one of two overhead concrete ash bunkers. When full, the water is drained from the ash, which is then discharged into road lorries for disposal.

Feedwater treatment plant

The feedwater treatment plant installed in the new power station was designed and supplied by Neckar Water Softener Co. Ltd. to supply the requirements of the South Mill boiler plant in addition to those of the new boilers, and careful laboratory control is exercised over the whole process. The capacity of the new plant is 15,000 gal./hr. and it comprises a single line re-action tank in which the raw water is pre-treated by hot lime process, and three pressure filters and three zeolite tanks for after treatment to give a zero hardness water. Heating of the water in the lime treatment is arranged by steam supply to give a temperature of 160 deg. F.

Electrical power

The boilers supply steam to two turbo-alternator sets, supplied by Metropolitan-Vickers Electrical Co. Ltd., the main machine being of the pass-out condensing type generating at 11-kV 3-phase, 50 c/s, rated at 7,500-kW and designed to pass out up to 120,000 lb./hr. of steam to process at a normal pressure of 30 lb./sq. in.

The turbine is of the single-cylinder impulse type with one velocity stage and seventeen impulse stages from inlet to pass-out, and with one velocity stage and four impulse stages from pass-out to condenser. The turbine is fitted with oil relay governor gear. The alternator is of the totally-enclosed forced-ventilating type, with a water-cooled air cooler. With no steam being taken from the pass-out branch of the turbine an output of 3,500-kW is obtainable from the set operating as a fully-condensing machine with 3,000 gal./min. of circulating-water supplied to the condenser at a temperature of up to 65 deg. F. The condenser is installed below the turbine, in the basement. It is of the three-pass type with fabricated sheet shell, and with hinged end-doors. The auxiliary generating plant comprises a back-pressure set, which is installed in the turbine house basement, with the controls and instrument panel at operating floor level. The turbine is a five-stage machine taking steam at boiler pressure and temperature, and operates at a speed of 8,500 r.p.m. The exhaust pressure is controlled for normal running at 170 lb./sq. in., and the capacity of the alternator is 500-kW when the turbine steam flow is 27,000 lb./hr. The supply of circulating-water for the condensers is drawn from the Kennet and Avon canal through a pumping station on the canal bank, and delivered to a 320,000 gal. storage tank in the North Mill site. All motors, with a few exceptions, and ranging from fractional to 270 h.p., are of Mather and Platt manufacture.

Feed-pumps and station pipework

Five feed-pumps are installed in the turbine room condenser basement annexe below the firing floor of the boiler house. Three pumps are Mather & Platt motor-driven pumps, one being large enough to feed both boilers, and the other two each 50 per cent. capacity. The remaining two, also of 50 per cent. full capacity each, are G. & J. Weir steam-turbine driven pumps for use in the event of an electrical failure.

The whole of the station pipework was fabricated and erected by Stewarts & Lloyds Ltd., while the valves, etc., were supplied by Hopkinsons Ltd. Except where piping joins valves or terminal flanges on plant, the high-pressure piping joints have been welded throughout and gamma-ray tested on site. Pipe joints on all low-pressure services are flanged and bolted throughout. A 7-in. bore steam main has been brought over from South Mill boiler house to supply in emergency, or in holiday "shut" periods, up to 60,000 lb./hr. to the low-pressure process steam distribution system.

The insulation materials were supplied and installed by The Cape Asbestos Co. Ltd. All low-pressure steam and condensate pipes 4-in. bore and under were lagged with 1½-in. thick "Caposite" asbestos preformed sections, canvas wrapped and painted to Colthrop standard colour identification schedule. All steam and condensate pipes above 4-in. bore were lagged with 1½-in. thick "Rocksil" medium density flexible sections.

De-aerator

The whole of the feedwater supply to the feed pumps is de-aerated in a de-aerator supplied by G. & J. Weir Ltd., and located on the 27-ft. floor level. The water flows by gravity from the surge tanks to a de-aerator and then to the feed pump suction main. The water through the de-aerator is float valve controlled and is heated to 200 deg. F. whilst a steam operated ejector maintains a corresponding vacuum in the de-aerator chamber. The oxygen content of the feedwater is reduced to not more than 0.02 c.c. per litre.

As a further precaution against scale formation in the boiler, a solution of tri-sodium phosphate is injected by high-pressure pump directly into the rear top boiler drums so as to maintain an excess of phosphate in the boiler water at all times. Continuous blow-down is maintained to keep the boiler water concentration to a safe figure and avoid any carry-over to the superheater.

Power distribution

Power is supplied to the mill via an 11-kV ring main, and a separate 11-kV ring main feeds the circulating-water pump house. A standby supply at 11-kV from the Southern Electricity Board network necessitates switchgear of 250-MVA rupturing capacity. This switchgear has been supplied by British Thomson-Houston Co. Ltd.,

and is of the solenoid-operated air-insulated vertical-isolation single-busbar type.

There are two substations in the mill, situated as near as possible to the load centres, and at each of these there are two 2,000-kVA transformers interconnecting the 11-kV and 415-V switchboards. The main 415-V " AJ " circuit-breakers are of British Thomson-Houston manufacture, and these supply the various multi-motor contactor switchboards supplied by Igranic Electric Co. Ltd.

Effluent treatment

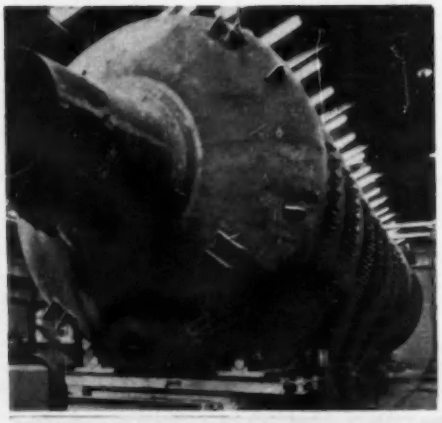
The effluent from the mill is passed to a clarification plant consisting of two 50-ft. diameter Dorr Clarifloculator tanks with rotating scraper mechanism, the plant being capable of handling 600,000-gallons per day. The clarified water is then pumped to percolating filters for further treatment before being returned to the canal.

Motors

All motors in the station, with a few exceptions, ranging from 270 h.p. to fractional h.p., were supplied by Mather & Platt Ltd., all are squirrel-cage wound, with class " B " insulation, and are either drip-proof, or totally-enclosed, coupled to their drivers by Wellman Bibby couplings.

PROGRESS AT BRADWELL

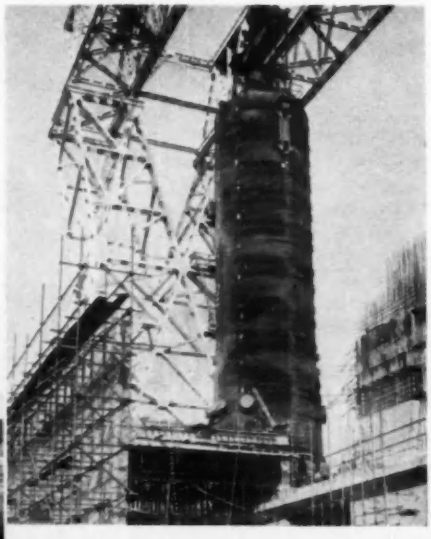
During the latter part of May the first of twelve heat-exchangers for the nuclear power station now under construction at Bradwell, Essex, was launched into the River Tees near the works of the manufacturers, Head Wrightson & Co. Ltd., a member firm of the Nuclear Power Plant Co., and towed by a tug to Bradwell. Here it was floated into position above a road low-loader on a specially-constructed concrete slipway, and as the tide fell the weight of the vessel was taken on the vehicle which was then hauled out of the river, and to the power station site. On June 4th the heat-exchanger, which weighs over 200 tons, and is over 90-ft. in length, with a diameter varying from 19-20-ft., was lifted into position by the Goliath crane, described in the May 1958 issue of this journal.



(Left). The heat-exchanger during the final stages of construction at the Thornaby Works of Head Wrightson & Co. Ltd.

(Below). Launching the heat-exchanger into the River Tees.

(Right). The heat-exchanger being raised into position by the Goliath crane at the Bradwell site.



The completed station at Bradwell will comprise two nuclear reactors which will generate heat to provide steam from the twelve heat-exchangers, three vessels being positioned on two sides of each reactor. Water will enter at the bottom of the heat-exchangers and flow upwards through low- and high-pressure systems constructed of special finned tubing, eventually being converted to superheated steam by the hot CO_2 gas circulating through the reactor. The tubes are grouped in three banks (i.e., economiser, evaporator, superheater) and the steam conditions at the outlet of the superheater will be : low-pressure—87,500 lb./hr. at 210 lb./sq. in. and 704 deg. F. ; high-pressure—170,833 lb./hr. at 770 lb./sq. in. and 704 deg. F. The CO_2 will enter the top of the heat-exchanger at a temperature of 734 deg. F. and leave the bottom at a temperature of 350 deg. F., the static pressure being 10 atm. or approximately 150 lb./sq. in., with a flow rate of just over 3-million lb./hr. for each heat-exchanger. Clarke, Chapman and Co. Ltd. were responsible for the fabrication of the heat-exchanger tube elements.

In addition to the twelve heat-exchangers, Head Wrightson & Co. Ltd. are supplying for the Bradwell power station the shield cooling equipment, the support plates, bearings, restraints and charge pans for the graphite core ; the carbon-dioxide storage plant ; the gas blowdown system ; the carbon-dioxide pile cap piping ; the carbon dioxide interconnecting piping ; the pond cooling system ; and the complete effluent treatment plant.

It has been announced by the State of Guernsey that its Water Board is to construct a plant for evaporating sea-water for use in supplementing normal water supplies. Provisional tenders have been received from **G. and J. Weir Ltd.** and from **Richardsons Westgarth and Co. Ltd.** It is anticipated that the plant will be in use in about eighteen months' time.

Standardisation of Control Facilities for the National Electricity Grid

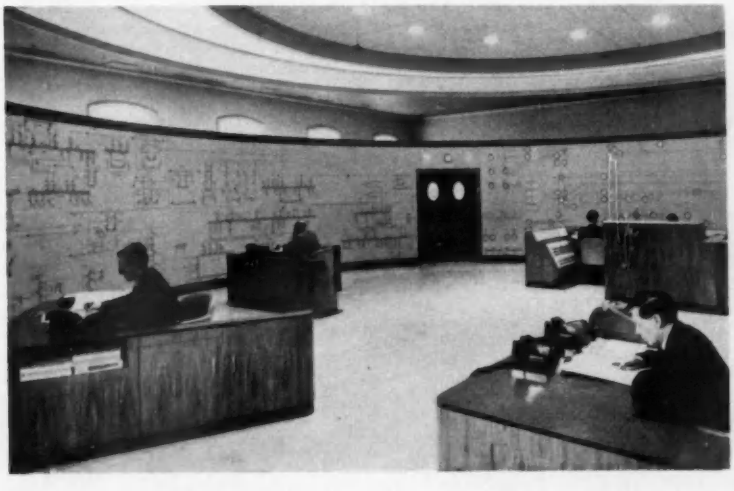
THE Central Electricity Generating Board's national electricity grid, consisting of 260 power stations with an aggregate capacity of 22,000-MW, and 350 main distributing centres, or grid switching stations, is now controlled from a national control in London and from seven grid control centres situated throughout the country. These centres have recently been built to supersede the original grid control centres, and they incorporate all the latest techniques and apparatus, using communication and indicating equipment of a type which is standard to the entire system.

Since it was first put into operation some twenty-six years ago the grid has continued to expand, particularly during the second World War, until in 1949, the year following the nationalisation of the electricity industry, it was decided to re-equip the control networks with a standard system of indicating, telephone and telemetering equipment which could be extended as required to meet changing conditions. At the same time it was decided that because of the congestion at the existing grid control centres, and taking into account wartime experiences, new and larger centres should be built in more suitable districts. The seven sites chosen were at Newcastle, Leeds, Manchester, Birmingham, Bristol, Watford and East Grinstead, and to plan and design the "standardised system" a communications technical committee was formed, comprising representatives of the then British Electricity Authority, the Automatic Telephone and Electric Co., the General Electric Co. Ltd., and Standard Telephone and Cables Ltd.

In the "standardised system" the stations in a grid control area are classified as either major stations or minor stations. A major station is usually a generating station either with or without a grid switching station, or a large attended grid switching station not associated with a generating station. Only the major stations are equipped to send signals to, or receive signals from a grid control centre. Such a station normally has a direct line to a control centre, in which case it is termed a radial station, and has also a direct line to each minor station associated with it. A minor station is usually a small grid switching and transforming station or a bulk supply point to an Area Board, and these stations can only send signals to or receive signals from a major station.

It was decided to continue using rented G.P.O. lines, and in order to economise in these rented circuits the more distant major stations are connected in groups—usually of two, but up to a maximum of four stations—and served by a common line from the grid control centre to the nearest or most important station in the group, and from this parent station by separate lines to each of the satellite major stations in the group. Pairs of major stations served by separate lines to the centre are interconnected by tie lines to provide an alternative, although indirect, means of communication with the grid control centre. The more important radial stations may have second lines to the centre which are switched to take over service should the normal line fail. In everyday use reserve lines operate as inter-PAX tie lines between the grid control centre and the stations. Tie lines and reserve lines are routed by the Post Office to avoid cables containing the grid control lines.

A new network is now being provided for the full-scale transmission of general indications, telephony and telemetering to a new National Control Centre in London from the various grid control centres and for communication and standby telemetering facilities between the South of Scotland Electricity Board's grid control centre at Glasgow and the National Control. This network will also provide direct communication facilities between the various grid control centres and connect with standby National Control Centres. The G.P.O. teleprinter network between the National Control and the seven control centres is to be retained to reinforce the new network.



The control room of the North Thames Grid Control, at Watford. On the left can be seen the switching diagram, and on the right the feeder-flow diagram.

Control centre equipment

The main units in each of the grid control rooms are the switching diagrams, feeder flow diagrams, and the control desks. Since they have proved satisfactory over the past 20 years mosaic switching diagrams are used, comprising thousands of interchangeable plastic squares which are either blank, or engraved to portray various items of transmission equipment and

switchgear and coloured to represent the appropriate system voltage. The circuit-breaker symbol is a manually-operated semaphore which flashes until corrected by the switching control engineer. The feeder flow diagrams incorporate telemeters in mimic power lines which indicate the magnitude and direction of active and reactive power flow in the various 275-kV power lines and transformers and in the majority of the 132-kV lines. In each line a red lamp flashes when the current exceeds a preset value, while at the line ends green lamps light whenever the switchgear opens the line.

Facing the switching diagram is a control desk for each of the two switching engineers. The desks are equipped with keyboards for calling or answering any control telephone in the area with overriding priority over inter-office traffic. On the loading desk which is in front of the feeder flow diagram and usually has accommodation for two engineers, chart recorders indicate area net transfer, area total generation and system frequency. Other instruments indicate rate of change of system frequency and daylight intensity as telemetered from the main industrial load centre of the area. The loading desk also incorporates a 16-way message instructor for the various out-stations, and on an adjacent console there are individual power station MW generation instructors.

At each power station there is provided a control telephone and local telemeter indications similar to those telemetered to the grid control centres, while in addition there is an indicator which responds to the grid control loading engineer's generation instructions, and combined lamps and twist buttons for the display and acceptance of visual instructions transmitted by the loading engineer, together with a means of re-lighting the last instruction received. Attended transmission stations can, if required, be provided with visual instruction facilities for load reduction and restoration purposes. Unless remotely controlled by the Area Board concerned, unattended minor stations are controlled by means of the " standardised system " over the grid control network by the Generating Board from the associated major stations which are usually generating stations and therefore attended. As a precaution against the failure of a rented line, however, this method of control is reinforced at the minor stations by automatic reclosure of the grid circuit-breakers.

Signalling and speech facilities

G.P.O. lines between stations and grid control centres can be up to 150 miles in length, but under normal conditions they are short enough to allow earth return d.c. phantom signalling, which is inexpensive and does not interfere with speech or V.F. telemeter signalling. It is unaffected by line reversal and at stations where isolation is not required the earthed positive pole 50-V station batteries are used for line signalling. As this precludes the polarising of train marking impulses they are marked by increasing the make period from 50 to 160 millisec. Unmarked pulses are transmitted at the rate of 10 a second with equal make and break periods. On lines where d.c. earth return signalling cannot be used the established practice of using 300 c/s tone signalling is retained with the speech band restricted at the lower end to 400 c/s and interrupted 480 c/s for the ringing and busy tones. This system is employed between the grid control centre, parent and satellite stations to minimise impulse distortion on trains relayed by parent stations, and because inter-station dialling between parent and satellite stations requires the d.c. channels. The speech band is also restricted to an upper limit of 2,000 c/s to allow the simultaneous transmission of speech and telemetering at 2,220 and 2,340 c/s.

From the control centres the d.c. or 300 c/s signalling channel is used to select visual messages or generation instructions at the stations and to set up telephone calls. The same channels are used from the stations to signal telephone calls and the indications of circuit-breakers, automatic isolators, overload feeders, direction (import or export) of telemetered power transfers, loss of telemeter channels between stations and acknowledgment of visual message instructions. To prevent lock-out due to channel congestion during heavy traffic, the selection, indication and telephone signal trains use the common signalling channel in turn.

When an indication train is transmitted from a satellite station it is relayed to the grid control centre by the parent station, which, together with the other satellite stations, is then prevented from sending an indication train. With an additional group selection code, selection trains from the grid control centre are relayed by the parent station into the local equipment or to the selected satellite station. The telephone system used in the " standardised system " is most comprehensive and incorporates many novel features and facilities to enable it to meet the operational requirements of the Central Electricity Generating Board.

Telemetering

An electronic multiplex telemetering system has been adopted in the " standardised system," and this uses " start-stop " time division with 20 millisec. marking, and scans ten meters in 200 millisec. three times a second. In the control centres the decoded impulses operate electronic telemeters to produce d.c. voltages directly proportional to the impulse rates. Indications of the direction of telemetered power flow are transmitted by the general indicating system as a point indication. This allows the full capacity of the multiplex system to be used for telemetering.

Intertripping and protection

The original systems for intertripping of grid circuit-breakers between grid stations using the control networks were low-speed (0.8 sec.) and these became outmoded when the use of automatic 132-kV fault-throwers to clear transformer and l.v. faults were approved provided the fault level did not exceed 500-MVA. However, intertripping was still required in some situations and a number of high-speed systems have been installed during the past five years. A recent development provides for the transmission of signals, initiated by high-speed line protection, to accelerate the operation of remote distance protection equipment or to unlock inhibited directional overcurrent relays at remote transformer feeder stations.

G. & J. Weir Ltd., Glasgow, have received an order from The English Electric Co. Ltd., for ten electrofeeders for Hinkley Point—the largest nuclear power station in the world, and which will have a net electrical output of 500-MW. The Weir order includes eight main feed-pumps each discharging 1,150,000 lb./hr. at 882 lb./sq. in., and two emergency pumps each with an output of 120,000 lb./hr. at 882 lb./sq. in.

Twenty-Five Years of Progress at Danfoss

IN the July, 1956, issue of this journal we published an account of our impressions following a visit to the Danfoss Works at Nordborg, Denmark. Recently we had the opportunity of paying another visit to Danfoss, as July 3rd marks the occasion of the Silver Jubilee of the organisation. The programme at Danfoss is one of continued success and expansion, as was clearly evident during our recent visit.

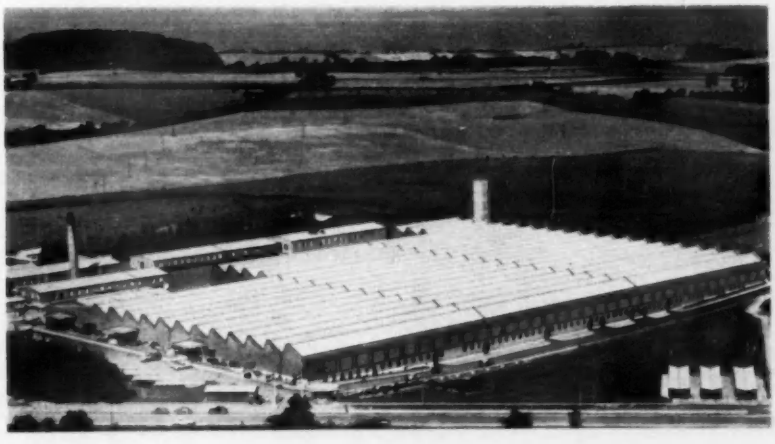
The growth and achievements of, and the eminent position which has been built up by the organisation within the comparatively moderate space of twenty-five years (including the five difficult years of the second world war) are truly remarkable ; as Danfoss now is Europe's biggest factory engaged in the manufacture of controls and control equipment for refrigerating and for heating plants, and the largest manufacturers of hermetic refrigerating compressors. The organisation was founded by Mr. Mads Clausen in 1933, when, in a very small way, he commenced the manufacture, on his own account, of thermostatic expansion valves for refrigeration plants. Mads Clausen had, after attending the Technical High School at Odense, been trained as a refrigeration engineer, and was eventually employed as such with one of the largest Danish manufacturers of refrigeration plant and associated equipment.

The fantastic rate of development at Danfoss is somewhat difficult to understand when it is realised that only twenty-five years ago this month Mads Clausen made his very modest and somewhat primitive start during the night and early morning hours in the bachelor establishment where he resided during the last year in which he was employed with the large Danish refrigeration firm at Vojens.

Later, Clausen transferred his activities to the village of Elsmark on the island of Als, a small island at the foot of the Jutland peninsula where he had spent his boyhood years. Here more space was available, viz. in a loft having an area of about 200 sq. ft. in the main building at his father's farm. Elsmark village adjoins the small town of Nordborg, which is not far from the present Danfoss Works, whilst the nearest and only sizeable town on the island is Sonderborg with a population of approx. 20,000, and in which, at present, the larger proportion of Danfoss workpeople reside. But the population of Nordborg has increased from some 900 in 1933 to about 2,100 today and many of these people are employed at Danfoss whose factory, now employing 3,000 people, is located in the heart of the countryside.

At the very beginning, Mads Clausen was fortunate in being able to enlist the services of two of his former fellow apprentices—two brothers who hailed from the nearby village of Vollerup, and who had returned home after a stay in the U.S.A. Thus, Clausen with his two associates, and with the use of a lathe, a drilling machine and suchlike began to produce the components for the very first valves which were duly completed, tested and dispatched to a factory in Copenhagen, and in which they were to be used.

It appears that during the first month of activities, sales amounted to 277 kroner (about £15) and for the whole of 1933 (the first year) to 15,000 kroner (about £775). The next year the figure reached 87,000 and by the third year (1935), the total was 131,000 kroner (about £6,620). Also, it was in 1935 that the first workmen were engaged, one or two additional machine tools were acquired, and activities really centred at Elsmark in a building of wooden construction erected near the farmhouse of Clausen's father. During 1936, a few additional workmen were taken on, and from then until the outbreak of war in 1939, the undertaking, the original name of which was Dansk Koleautomatik- og Apparatfabrik (Danish Refrigeration Controls and Apparatus Factory), grew steadily with the result that by the end of 1943 the total workshop area under cover and available for production activities had reached 800 m.^{2} (8,600 sq. ft.). By this time the enterprise had existed for ten years, and the manufacturing programme comprised thirty-seven different types of apparatus. For the refrigeration industry there were automatic and thermostatic



Aerial view of the Danfoss works near Nordborg on the Island of Als at the foot of the Jutland Peninsular, Denmark.

expansion valves, automatic water valves, thermostats and pressure controls, solenoid valves, check valves, diaphragm-sealed valves, filters, bellows, seals, etc. In addition, Danfoss had by this time made an entry into the heating industry, for the requirements of which boiler thermostats, water-level control apparatus, pressure valves and various types of control equipment for oil-burners were made. For the compressed-air industry, pressure switches, float switches, starting relays and other components were being manufactured.

Throughout the war years things had, of course, been difficult, transport was a serious problem, as was the means of obtaining raw materials, capillary tubes, copper piping and a host of other items. But these problems were tackled and, in due course, overcome.

During 1945, an appreciable area of land adjoining the main Sonderborg-Nordborg highway was acquired, and here the real and ultimate works was to be constructed. Early in 1946 the announcement was made that "Danfoss" had been registered as the official name of the firm. Permission for the purchase of the necessary building materials was still unobtainable, and thus the rebuilding of German military hutments which had been used during the occupation had to be resorted to. This procedure continued until the spring of 1950, by which time some 5,000 m.^{2} (approx. 54,000 sq. ft.) of workshop area was available. About this time manufacturing progress was rapid, and it was resolved to embark upon the construction of a modern and well-equipped factory. The foundation stone was laid in July, 1951, and a few months later a visit to Danfoss was made by the King and Queen of Denmark.

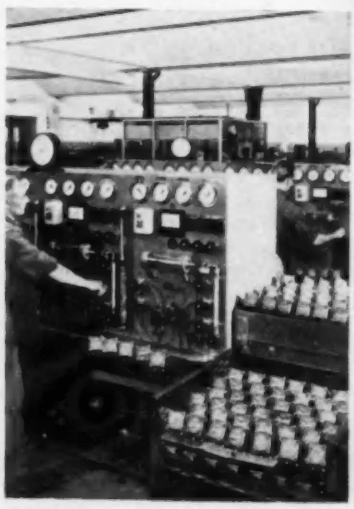
Occupation of the new factory began during January, 1952—the available workshop area at that time being

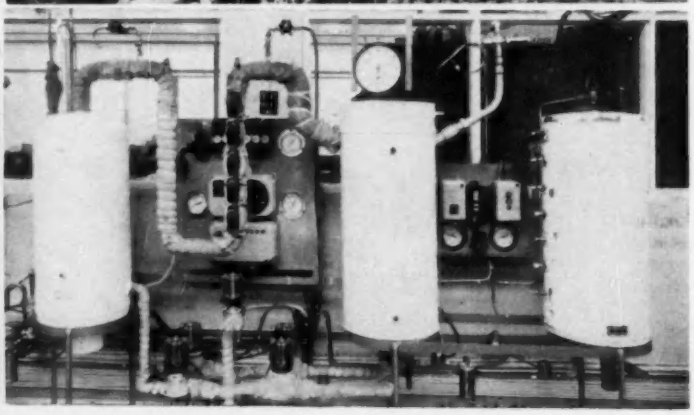
(Above). *One of the three drawing offices in the Danfoss design department.*

(Right). *Pillar drilling machines in one of the workshops in which fuel-oil pumps are made.*

(Below, right). *Test bed for checking performance data of various components.*

(Below). *Final testing of Danfoss oil-fuel pumps.*





about 5,000 m.² (about 54,000 sq. ft.), plus an extensive basement area of about 1,300 m.² (11,000 sq. ft.) which included wash rooms and dressing rooms for the workers, works heating plant, and corridors and tunnels for the pipework associated therewith. The combined staffs of the administrative department and the works now numbered nearly 800. By 1955 the total number of employees had reached more than 2,300, and the area of the combined administrative and factory buildings an area (floor space) of 38,000 m.² (about 409,000 sq. ft.).

Moreover, the range of Danfoss products had been further extended, and included photo-electric flame controls, oil-strainers, a wide range of pressure controls, thermostatic gas-valves, control boxes for oil-burners, contactor starters, back-pressure regulators, etc.

Today, many additional items have been added to the list of Danfoss products, which is so comprehensive that the four main catalogues detailing those products for each industry group, are printed in seven different languages.

The Danfoss journal, which was published for the first time in July, 1943, has since been published quarterly, including (since the beginning of 1946) an English edition. Today, well over 50,000 copies of the journal are published in seven other languages. The first branch office of the organisation was opened in Copenhagen at the end of 1946, with other Danish branch offices at Aarhus 1951, at Odense in 1952, and at Aalborg in 1954. In 1952 a branch office was opened in London, as was one in Canada (Toronto). Since then, branches have been established in most of the European capital cities, and official agencies appointed in all parts of the world.

An interesting example of Danfoss production today concerns hermetically-sealed compressors of which some 2,500 per day are being made in addition, of course, to the vast amount of automatic controls and associated equipment and components for refrigeration plants and for heating installations, and in fact for use in a wide range of other industries.

The number of units leaving the Danfoss works at the moment amount to approximately 15,000 per day, and Danfoss exports during the first three months of this year was 1.5 per cent. of the total Danish export trade, or 4 per cent. of the total Danish export of industrial products.

The present position is, that Danfoss, in its Jubilee year, has become an institution in itself. Employment is given to 3,000 people, the area covered by the factory and administration buildings totals about 50,000 m.² (about 540,000 sq. ft.), and the organisation represents an outstanding example of a rapid and efficient changeover of the activities of a community of appreciable size and who were largely engaged in agricultural activities, to modern and large scale industrial production.

The organisation now comprises six separate divisions, each controlled by a director who is assisted by a chief engineer and various departmental managers—all engaged in design, production and development of the most comprehensive range of automatic controls and associated equipment.

There is a large project and research department, and in addition, each major engineering group has its own laboratory for specific development work for Danfoss

(Above). One of the main bays containing automatic machines for producing a wide range of valves and components for Danfoss controls.

(Left). Stamping bay showing (left foreground) a large press for the hot-stamping of brass bases for various types of Danfoss thermostats.

products which now find their way to practically all the countries of the world.

The staff of the technical department set out to establish as far as possible, personal contact with all Danfoss customers in order to provide first-hand information concerning the installation, application and operation of the comprehensive range of the firm's controls and equipment.

Mr. Mads Clausen, the Danish refrigeration engineer who founded Danfoss twenty-five years ago, and who has been mainly responsible for the pre-eminence and success which the organisation has achieved.

Reference should be made to the building and maintenance department of the organisation. This department is responsible not only for electricity, gas, and water supplies, but also for the construction of all new buildings, and works extensions. It is self-contained with architectural and technical staffs, and tradesmen of all building catagories. At the present time, the building department are commencing the construction of a vast new administration block which will house all executives of the technical, sales, secretarial and other departments.

The works electricity consumption today is approximately one million kWh per month, while compressed-air plants to serve production requirements, total some 600 h.p.

In order to accommodate some of the Danfoss workpeople, housing estates have been, and are still being, developed in the nearby villages. Much of this housing development is State-aided, and workpeople wishing to purchase their own houses can (if they have been employed at the factory for a minimum period of three years), enjoy the benefit of a Danfoss building grant or loan.

To mark the Jubilee of the Danfoss organisation, the executives, agents, workers and so forth have decided to present Mr. Clausen with a "Danfoss Institute" which will be devoted to special training of technologists and others in the technique both standard and advanced, of the principles of the refrigeration, heating, air-conditioning, compressed-air and water supply industries.

EVERSHED & VIGNOLES LTD.

A new office block at the Acton Lane Works, Chiswick, London, W.4, of Evershed & Vignoles Ltd., was formally opened by Sir Christopher Hinton, K.B.E., F.R.S., chairman of the Central Electricity Generating Board, on June 11th, 1958. Sir Christopher was introduced by the chairman of Evershed & Vignoles Ltd., Mr. J. C. Needham, and before performing the opening ceremony he spoke of the tremendous developments that had taken place during the forty-five years since he first entered the chemical industry. He thought that these developments could still go far beyond where they stood today and that we were not by any means at the end of the potential development of complete process control, but in seeking further applications it would be necessary to have in mind that some of the major problems in achieving these further applications were human and psychological.

Evershed & Vignoles was founded by Mr. Sydney Evershed and Mr. E. B. Vignoles in 1895 when they purchased the instrument business of Easton, Anderson & Goolden, Ltd., taking over that company's works at Woodfield Road, Westbourne Park, which at the time employed twenty-five instrument makers. In 1903, the works was transferred to the present site at Chiswick, and today the number of employees is in excess of 1,700. Evershed had made a careful study of methods of electrical measurement, and he had carried out investigations of the phenomena manifested by insulating materials when subjected to electrical stress. The results of his work materialised in 1903 with his invention of the first insulation tester incorporating a moving-coil ohmmeter and hand generator in one case without magnetic interference, and before many years passed, "Megger" testing sets were in use as standard equipment throughout the world. Development extended the range to include Bridge-Megger instruments, Ducter low-resistance testing sets and earth testing instruments. In other directions, too, the scope of the company's activities widened. Portable and switchboard instruments were developed; the manufacture of chart recorders was begun in 1906; and in 1910 the company entered the field of water purity testing with the Dionic water purity meter. Experienced gained in the production of marine equipment led to the development, between the Wars, of apparatus for distant indication and control, while a further and more significant extension of the business has taken place in recent years with the company's entry into the instrumentation field. In the sphere of analytical chemistry, the Tinsley polarographs manufactured by Eversheds are widely used; temperature measurement is covered by optical and radiation pyrometers; a wide range of fractional horse-power motors and servo systems is manufactured; and the measurement of non-magnetic coatings on ferrous bases is catered for by the Tinsley thickness gauge. To deal with this wide range of equipment the company has now been divided into three main divisions, the Instrument Division, Instrumentation and Controls Division, and the Naval Instrument Division.

275-kV Crossings of the Rivers Severn and Wye

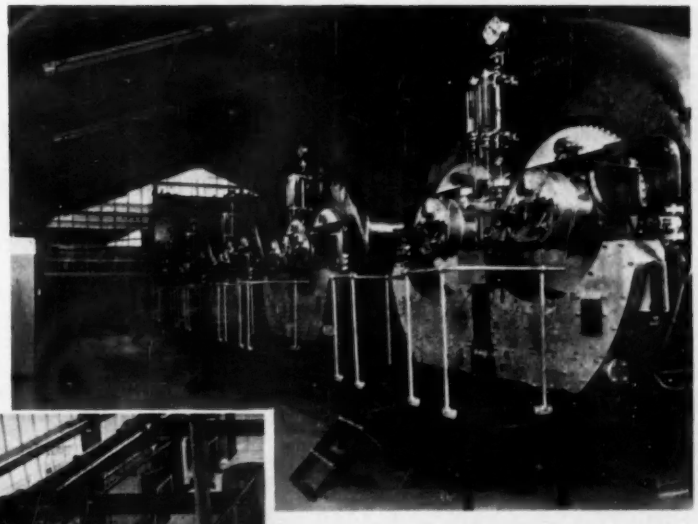
Work has now started on the construction of the Central Electricity Generating Board's 275-kV overhead-line crossing of the Rivers Severn and Wye. This is the largest crossing to be constructed in the United Kingdom and will carry two 275-kV circuits between Melksham (Wilts) and Uskmouth (Mon.). The incoming transmission lines at each end of the crossing are to one of the Board's standard 275-kV designs, having twin 0.175 sq. in. copper equivalent s.c.a. conductors per phase. These lines have a nominal capacity of 375,000-kW per circuit. The Severn and Wye crossing comprises three spans and four towers, i.e., two high crossing towers and two anchor towers. The total length of the three spans is just over 2¼ miles. The site is about 330 yards downstream of the proposed Severn suspension bridge, and is adjacent to the route of the Aust-Beachley Ferry. In order that the crossing should have a close measure of alignment with the future bridge, the high crossing tower on the Aust side of the river is to be built on an artificial island about 300 yards from the base of Aust Cliff. The other crossing tower will be built on the southern tip of the Beachley Peninsula. A summary of the main dimensions of the towers, conductors and insulation is as follows: total length of crossing 12,000 ft.; main crossing span (over the Rover Severn) 5,310 ft.; Aust anchor span 2,830 ft.; Beachley anchor span (over the River Wye) 3,860 ft.; overall tower heights (above base) 488 ft. (Aust), 471 ft. (Beachley); main span maximum sag 264.5 ft.; minimum clearance, at mean high water, spring tides 135 ft.

Central Boiler Plant Installation at Derby Works of Rolls-Royce Ltd.

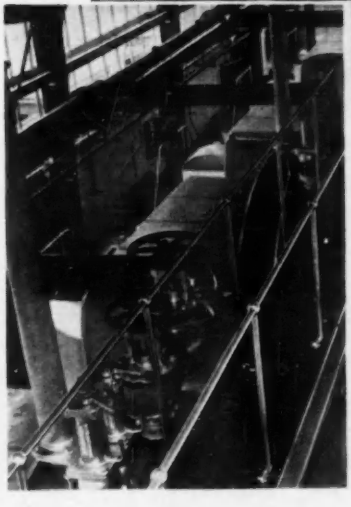
THE Rolls-Royce Group of Companies have undertaken a major reorganisation of the steam services to a number of their factories, and as part of this scheme a new central boiler plant installation has been constructed at the Group's Nightingale Road Works, Derby. The new plant, which comprises five Super-Economic "Contraflo" boilers, replaces two separate installations with a total of ten boilers of the Lancashire and locomotive types, and is housed in a steel portal-framed building, 97-ft. 8-in. long, 40-ft. wide and 26-ft. high to the ridge, with patent glazing extending from 10-ft. above floor level on all sides including the gable ends. The roof is constructed of galvanised steel decking, insulated with insulation board of ½-in. thickness, and covered with a mineral-surfaced felt. A continuous ridge-type ventilator and a large number of openable windows provide the necessary ventilation. The chimney associated with the boiler plant is 120-ft. high, with an internal dia. of 6-ft., and has been built of local facing bricks to conform with buildings in the immediate vicinity.

All the boilers in the new installation are oil-fired, the oil being stored in three storage tanks with a total capacity of 440 tons. The tanks are unlagged, but are provided with steam heating coils and electric outflow heaters; the latter being used during starting-up periods. The boilers themselves were supplied by Danks of Netherton Limited, and each has a design capacity of 14,000 lb./hr. at 120 lb./sq. in. (from feedwater at a temperature of 170 deg. F.) when burning oil having a viscosity of 950 or 3,500 seconds Redwood No. 1 at 100 deg. F. They are operated under induced-draught conditions and are fired through pressure-jet burner equipment supplied by Clyde Fuel Systems Ltd., the oil supply being taken from the storage tanks via an oil pumping and heating unit. This comprises two steam heaters, either of which is capable of maintaining the supply when the boilers are operating on full load; a Dunlow electric oil-preheater rated at 18-kW, which is used for starting-up purposes; and two electrically-driven, internal-gear, rotary-type oil-fuel circulating pumps, each of which is of sufficient capacity to meet the full load requirements of the plant. The boiler insulation work was carried out by J. Hindle & Co. and comprises Fibreglass lagging of 2½-in. and 2-in. thickness, the whole being supported by 1-in. mesh wire netting and finished with a ½-in. thickness of a hard-setting compound.

A 5,000 gal. capacity feedwater storage tank is provided, with the admission of make-up water controlled by a Mobrey magnetic level-switch which operates a motorised valve in the softened water supply line. The level-switch admits water when the boiler is one-third full, and closes the inlet cold-water valve when the level of the feed-tank has been increased by 10-in. This procedure has been adopted to prevent the overflow of large quantities of condensate during periods when the steam supply to the factory area is first turned on. Two vertical, single-cylinder, double-acting feedpumps were supplied by G. & J. Weir Ltd., each of a sufficient capacity to meet the full rated output of the boiler plant. Exhaust steam from the feedpumps is condensed and returned to the boiler feed-tank. Each boiler is provided with a



(Above). The five Super-Economic "Contraflo" boilers supplied by Danks of Netherton Ltd., which form the new central boiler plant installation at the Nightingale Road Works, Derby, of the Rolls-Royce Group of Companies. All the boilers are oil-fired, and each has a design capacity of 14,000 lb./hr.



(Left). A cat-walk at the rear of the boilers has been provided in order that the necessary valves concerned with the operation of each unit may be completely accessible.

Ronald Trist Thermofeed control ; an automatic regulating valve in the feedwater supply line ; and a control valve in the auxiliary steam line. In addition, each unit is fitted with a Mobrey low-water alarm, also supplied by Ronald Trist & Co. Ltd.

All the boiler make-up water is treated in a 5,000 gal./hr. capacity base-exchange water softening plant supplied by Feedwater Specialists Co. Ltd., and when handling town water, this unit can soften a total of 80,000 gal. between regenerations. Further water treatment takes the form of additions of Calgon and caustic soda (supplied by Albright & Wilson Ltd.) and applied in amounts controlled by the works chemical laboratory staff.

All the necessary valves concerned with the operation of the boilers have been fitted towards the rear of each unit and are completely accessible from a cat-walk, while to avoid unsightly high-level feedwater mains, these have been arranged in trenches which run the full length of the boiler house.

Instrumentation and control equipment

The control panel associated with the new boiler plant was designed and installed by the works instrument department, and incorporates a Mono Co_2 recorder (supplied by James Gordon & Co. Ltd.) for each boiler ; an Electroflo steam-pressure indicator, steam-flow indicator, steam-pressure and flow recorder, and steam meter integrator ; a Ronald Trist smoke-density indicator and recorder ; make-up water meter integrator ; a George Kent multi-point temperature recorder for exit gas, feed tank, outside air and boiler house temperatures ; and an Electroflo oil-fuel temperature indicator. Safety controls include flame failure equipment and Mobrey low-water alarms, while to prevent damage to the water-cooled bearings of the i.d. fan provided for each boiler, Igranic flow-switches are incorporated in the fan cooling circuits, which in the event of the flow of water being restricted or failing completely, will automatically close down the fan together with the oil-burning equipment of the boiler concerned.

The new plant has now been in operation since the latter part of 1956, and some interesting figures are available for comparison with the old installation. During the summer months, when there is no space-heating load, the weekly fuel consumption has fallen from 80 to 60 tons, and in the most severe winter weather from 315 tons to 215 tons. Taking annual figures, the maximum for the three years prior to the installation of the new plant was 8,994 tons in 1955, while the figure for 1957 was 6,495 tons. This represents a financial saving during 1957 of over £20,000, while there was a further saving of some £2,000 attributable to reduced labour costs for operating the one central boiler house as opposed to two smaller units.

Performance data shows that the exit gas temperatures from the new boilers are maintained at 400 to 450 deg. F. at all loads from 60 to 110 per cent. of the boiler rating, while at the same loads, CO_2 readings of between 11 to 13 per cent. can be obtained without difficulty. Although normally rated at 14,000 lb./hr., the boilers have, in fact, been operated for test periods at outputs in excess of 15,000 lb./hr.

New Factory for Foxboro-Yoxall Ltd.

FOXBORO-YOXALL LTD. was formed in 1934, when the Yoxall Instrument Co. undertook the manufacture in this country of instruments developed by the Foxboro Co. of America in addition to their own range. Mr. L. S. Yoxall, who founded the British company in 1931, is today the chairman and managing director of Foxboro-Yoxall Ltd.

The new company's first works were at Merton, a second factory was established at Kidbrooke in 1946, a third at Wandsworth in 1950, and recently, with the ultimate aim of providing a self-contained unit, with the whole of their production facilities concentrated under one roof, an entirely new factory has been constructed on a 58-acre site just north of Redhill, Surrey. Here, at the present time the buildings comprise an office block, a factory area of some 85,000 sq. ft., a power house, and a staff restaurant, all sited and planned for subsequent expansion.

The factory lies immediately behind the office block to which it is connected by covered ways. It is of single storey, north light construction and is, at present, 200-ft. wide and 425-ft. long. The walls are of brick to about 4-ft. and are then of glass up to the aluminium and glass roof. A feature of the new building is the absence of service lines, cables, conduits or pipes between the roof and the floor. All services are distributed through an underground tunnel which runs the length of the factory and has its main opening in the power house. Air, gas, water, heating and electricity supply lines all run through this tunnel, and all distribution boards, fuses and branch pipes are accessible from the tunnel.

Works production facilities are laid out on the modern circular system whereby goods enter and leave the building at roughly the same point, the goods circulating round central storage areas. Working conditions are of particular importance in the manufacture of high quality precision instruments, and much care has been taken to provide the best possible lighting, heating and ventilation. The use of north light construction and glass wherever possible ensures maximum daylight. Artificial lighting is by 1,200 × 80-W, 5-ft. fluorescent tubes designed to give a shadowless 30-lumens/sq. ft. Heating is mainly by unit heaters suspended from the roof and fed direct from the pressurised hot-water supply, but these are supplemented at certain points by natural-draught convectors fed from the same source, at 260 deg. F. and 45 lb./sq. in. Large " Colt " roof ventilators are used to extract stale air, and the intake of fresh air is controlled by the openable windows in the walls. Special extraction equipment is provided for such processes as paint spraying, acid dipping and packing.

The power house is large enough to house boilers and other installations of sufficient capacity to serve three times the present factory area. It is a tall, steel-framed structure with a glass-walled tower containing the main water tanks and the boiler flues , an arrangement which

obviates freeze-ups in cold weather, as well as presenting a more uniform exterior. At the present time the equipment installed includes the main electrical switch-gear. a stand-by Diesel generator, air-compressors, and circulating pumps for the heating and hot-water supplies. The actual boiler plant, supplied by Fraser and Fraser Ltd., comprises two oil-fired units, one rated at 9.5-million B.Th.U./hr. for heating supplies, and one rated at 1-million B.Th.U./hr. to cover the hot-water requirements. The larger boiler operates at 45 lb./sq. in. and 260 deg. F., with fuel-oil to the burner equipment at 210 deg. F. The oil-firing equipment including the heating and pumping units for both boilers was supplied by Nu-Way Heating Plants Ltd.

Manufacturing activities

Foxboro-Yoxall manufacture instruments for the measurement and control of process variables in a wide field of applications in the process industries. Instruments for the measurement and control of flow, temperature, pressure, liquid level are available and these are made suitable for indicating or recording the measured variable on a chart. Other variables include conductivity, pH, humidity, moisture and liquid density. Long distance transmission of the measurement signal is provided to meet applications such as are encountered when centralised control rooms are required.

Automatic control forms a major part of the company's activities. Foxboro air-operated controllers are designed to include a wide range of operating characteristics and full interchangeability of all parts in the field of operation. A wide range of accessories for use with the air-operated controllers is manufactured, including control valves, dampers, power cylinders and variable speed devices. These are used to vary the flows of materials in the processes, as part of the automatic control system. Control panels are also designed and assembled at the Redhill premises.

Ancillary departments at Redhill include a fully-staffed training school equipped to give practical courses in instrument maintenance and advanced courses in the theory of control instrumentation. There is also a research and development department, and the company now possess a fully-equipped hydraulics laboratory for the testing of all types of flow meters under working conditions.

A large service department provides an after sales service which is part of a world wide organisation, for the company is associated with an undertaking which has manufacturing centres in America, Canada, Japan as well as in Great Britain, and service depots and representatives throughout the world.

HARLAND WORKS EXTENSION

A new water-turbine shop at the Alloa Works of The Harland Engineering Co. Ltd. was officially opened on April 29th, 1958, by the chairman of the North of Scotland Hydro-Electric Board, the Rt. Hon. Thomas Johnston, C.H., LL.D., J.P., F.E.I.S. This plant extension, which is some 432-ft. long, 63-ft. wide and 45-ft. high, has now provided the company with the facilities to manufacture equipment for hydro-electric and pumped storage schemes of a capacity as large as those envisaged for many years to come. They can, for example, produce, under the correct hydraulic conditions, turbines having outputs in excess of 200,000 h.p., with overall dimensions greater than 60-ft. diam. In addition a larger number of small machines can now be manufactured. The crane lifting capacity installed is 70 to 100-tons, and other equipment associated with the extension includes a Hugh Smith plate-bending machine capable of handling 2½-in. thick sheets of cold mild-steel plate, 5-ft. wide, and 1¾-in. thick sheet, 10-ft. wide ; a 24-ft. Craven boring mill ; a 30-in. centre Craven lathe ; an 8-in. spindle Asquith horizontal boring mill ; and a 12-ft. vertical boring mill.

A general view of the new water-turbine shop at the Alloa Works of The Harland Engineering Co. Ltd.

The Harland Engineering Co. Ltd. were founded in 1903, and while their main works at Alloa concentrates on the manufacture of medium/heavy and specialist electrical and hydraulic plant, a further works at Timperley, Cheshire, produces spares and batch-produced standard plant, and operates as the service centre for the organisation. In addition to the manufacture of water-turbines and storage pumps with their valves and ancilliary plant, the company's products cover a.c. and d.c. electric motors and generators from 60 to 12,000 b.h.p./kW, and centrifugal pumps of all sizes.

It was towards the end of the second world war, when the North of Scotland Hydro-Electric Board was anxious to encourage the manufacture of hydro-electric plant in Scotland that The Harland Engineering Co. Ltd. decided to produce this type of equipment as a natural development of their existing work in the hydraulic/electrical field. To this end they entered into an agreement with the S. Morgan Smith Co., of America, and since then some 37 water turbines, including Francis, Impulse, and Kaplan machines of both horizontal and vertical-shaft types, have been supplied, the largest having an output of 30,000 b.h.p. With 26 of these turbines the associated synchronous or asynchronous generators up to 8.33 kVA have been manufactured by the company. Expressed in terms of h.p. output, just over 25 per cent. of all hydraulic turbines, and 40 per cent. of associated generators have been supplied to overseas customers.

Speaking at the opening ceremony, Mr. Johnston gave a hint as to the future of hydro-electric power, when he described a new venture involving the use of power generated in off-peak periods by the nuclear power station now under construction at Hunterston to pump water from Loch Awe up the shoulder of Ben Cruachan, to be stored, and then utilised for hydro-electric generation during peak periods.

James Hodgkinson (Salford) Ltd. have purchased the ordinary share capital of J. & J. Neil (Temple) Ltd., combustion engineers, Temple Park Iron Works, Glasgow, W.3. The board of this company has been reconstituted following the resignations of Mr. Neil, Mr. Welsh and Mr. Jarvie, and it now comprises **Mr. J. Douglas Cooper** (a former director) who is chairman, **Mr. N. C. Crighton, Mr. E. L. Hollinshead,** and **Mr. W. Murray,** the latter having been appointed managing director. Continuity of the business of J. & J. Neil (Temple) Ltd. is thus assured, and clients now have available to them the wider facilities of the whole Group, which comprises James Hodgkinson (Salford) Ltd., Bennis Combustion Ltd., A. B. Scorer Ltd., Bennis Mechanizations Ltd. and Saxon Engineering Co. Ltd.

RECENT Equipment AND Accessories

Hydraulic materials handling system

Orders for the Babcock & Wilcox Ltd. "Hyjector" jet-pump, a water-operated ejector unit for pumping a mixture of solids and water through a transporting pipeline, have already been received from the Central Electricity Generating Board for installation in the ash- and dust-handling plants at Uskmouth "B," Aberthaw and Willington "B" power stations. Solids are transported by means of a jet of high-pressure water which issues from a converging nozzle at high velocity, entrains and mixes with the solids, and discharges the mixture through a diverging throat. The pressure energy of high-pressure water is completely converted to energy of motion by the jet nozzle. The complete lack of pressure beyond the jet nozzle permits merging of water and ash admitted through the suction inlet with the jet water issuing from the jet nozzle. The mixture passes through the diverging throat which reduces the high velocity and, at this point, converts the energy of motion back to pressure energy. This pressure energy is the force used to overcome the resistance due to pipe friction and static head. The solid material, when discharged from the storage hopper, falls into a small feed hopper in which a jet of high velocity water from an auxiliary nozzle feeds the material into the suction inlet of the "Hyjector."

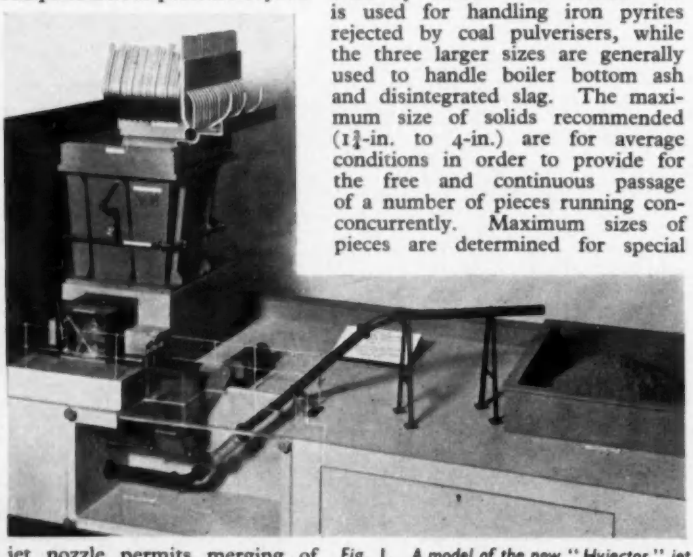


Fig. 1. A model of the new "Hyjector" jet pump for pumping a mixture of solids and water through a transporting pipeline. (Babcock & Wilcox Ltd.)

The material must be fed into the "Hyjector" under positive head and must not depend on the suction developed by the unit. Wear on the unit is minimised by (1) use of wear resistant materials; (2) use of few connecting joints within the equipment; (3) locating the high-pressure jet water nozzle tip out of the path of the material being transported, with the result that there is no interference with the free flow of solids, which prevents plugging and makes it unnecessary to back-wash the unit. The "Hyjector" may be assembled and dismantled easily. The inlet piece, throat and discharge piece are clamped together at each joint by four through-studs instead of bolt flanges. Babcock "Hyjectors" are available in four sizes, from 3-in. by 4-in. to 8-in. by 10-in. The smaller size is used for handling iron pyrites rejected by coal pulverisers, while the three larger sizes are generally used to handle boiler bottom ash and disintegrated slag. The maximum size of solids recommended (1¾-in. to 4-in.) are for average conditions in order to provide for the free and continuous passage of a number of pieces running concurrently. Maximum sizes of pieces are determined for special cases after all conditions are known. Before solid material is fed into the conveying system, provision is made to size it by means of a clinker grinder or by manually breaking oversize pieces on a grid. The quantity of solids that can be transported hydraulically through a pipeline depends upon the quantity of fluid/solid mixture flowing and the concentration of solids in the mixture. The quantity of fluid/solid mixture is fixed by the velocity of the mixture and internal diameter of the pipe. The total quantity of water required to operate a hydraulic materials-handling system is determined by the internal diameter of the pipe and by the desired pipeline velocity of the fluid/solid mixture. The total water required consists of that entering the suction inlet plus the high-pressure jet water. The water entering the suction inlet consists of the water used to discharge the solid material from the storage hopper and the water from the auxiliary feed nozzle. (*Babcock and Wilcox Ltd., Babcock House, 209, Euston Road, London, N.W.1.*)

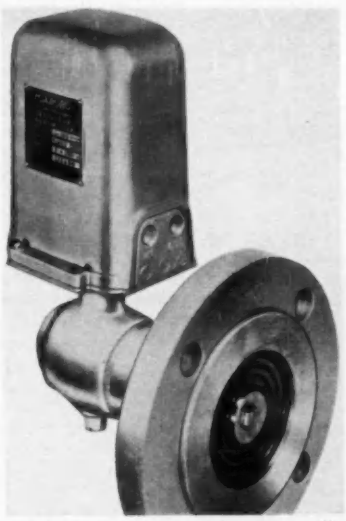
Heavy-duty small wheel grinder

The Airetool Manufacturing Co. have recently introduced a new air-powered production tool, the Model 400-G heavy-duty small wheel grinder. This lightweight tool has been designed specifically for general small wheel grinding on large dies, castings, patterns or other intricate construction. It is particularly useful for metal removal in precision die work, has many uses in production lines where speed and versatility of use are important. The tool is equipped with a positive lever throttle control for quick, safe starts and stops, and can also be provided with a button throttle if preferred. A further feature of the grinder is that it can be obtained in either collet chuck or spindle models for use with various grinding wheels or mounted accessories. An Airetool ball-bearing pneumatic motor operating at 19,000 r.p.m. is provided to drive the Model 400-G. The tool weighs only 1½-lb., and is 6½-in. long by 1½-in. dia. It has a ¼-in. collet chuck, or can be ordered with a ⅜-in. 24-thread spindle which will accommodate either a 1½-in. vitrified wheel or a 2-in. bonded wheel. (*The Airetool Manufacturing Co., Springfield, Ohio, U.S.A.*)

Liquid level transmitter

Foxboro-Yoxall Limited have recently added to their range of pneumatic transmitters a new instrument known as the type-13FA. It is a direct-mounted liquid level transmitter using the company's type-13A force-balance design to measure liquid level in open or closed vessels. It transmits an output air signal to standard 3-15 lb./sq. in. receiver recorders and controllers which may be locally or remotely mounted. The

sensing diaphragm is flange mounted to the side of the tank. This means that there are no process piping problems and the unit is thus particularly suited for the measurement of fluids of the viscous and slurry types. For open vessel measurement only the high-pressure side of the pressure measuring diaphragm and the raised serrated face of the cell flange are in contact with the process fluid. The low-pressure side of the diaphragm is vented to atmosphere. For closed



(Fig. 2, left). The new Foxboro-Yoxall direct-mounted liquid-level transmitter. (Foxboro-Yoxall Ltd.)

vessel measurement only an equalising leg is required. The twin diaphragm measuring element, liquid-filled and with a solid stainless steel core, is completely protected against accidental overrange. It covers the full range of the instrument—0-20 to 0-850-in. of water. Range changing is a simple matter of moving a range wheel up or down a range-rod fitted with a calibrated range scale. The instrument is suitable for use on pressures up to the rating A.S.A. 300 at 350 deg. F. maximum vessel temperature. The type-13FA is directly-mounted to the tank in any convenient position, vertically, horizontally or upside down. (*Foxboro-Yoxall Limited, Redhill, Surrey.*)

Dust exhausting and collecting unit

Among new products added to the Keith Blackman Ltd. "Tornado" range of fan engineering equipment is the T.2500 dust exhausting and collecting unit which has now been included in the "T" series units, six sizes of which are available for handling 250 to 2,500 cu. ft./min. of dust-laden air. The units are designed to safeguard machinery, improve working conditions and, thereby increase productivity by exhausting and collecting dust created by such machines as grinders, polishers and finishers. The T.2500 unit is the first to be fitted with a new "snap-action" mechanical shaking gear for dislodging fine dust trapped in the filters, the dust then dropping into a 5-cu. ft. dust tray at the foot of the unit. All units will in future be fitted with this device, with the exception of the T.250. The overall size of the new T.2500 is 6-ft. 6-in. high by 3-ft. wide by 3-ft. deep. It will serve

(Fig. 3, below). The new Keith Blackman T.2500 dust collecting and exhausting unit. (Keith Blackman Ltd.)

four reasonably spaced, double-ended grinding or polishing machines with 10-in. wheels, or a medium size scurfing or fettling booth. Keith Blackman "Tornado" high-efficiency, power-limiting fans together with the company's totally-enclosed motors are fitted to all units in the range. (*Keith Blackman Ltd., Mill Mead Road, London, N.17.*)

New level controller

In 1949 Fielden Electronics Ltd. produced a capacity operated level controller, which was given the trade name of Tektor. Recently a new and improved unit, the Tektor Major, has been made available, and a short note relating to this was included in a preview of the recent Instruments, Electronics and Automation Exhibition, published in the April 1958 issue of this journal. A more detailed description is given below. The Tektor Major consists essentially of a capacitance probe which is mounted in a predetermined position on the inside of the wall of the containing vessel. The probe is connected by coaxial cable to the instrument itself which can be mounted some distance away. In operation the proximity of the material in the container, with respect to the probe causes a change in capacitance. This change disturbs the balance of a capacitance bridge in the instrument and, at a predetermined level, operates a contactor relay, and lights an indicator lamp. The performance of the instrument is stated to be independent of cable length up to the specified maximum and a cable selector switch is fitted to enable the appropriate cable length to be provided for on site. Printed circuits are incorporated for reliability, and the Major has a control knob on the front of the chassis which enables the set-point also to be easily adjusted on site. Other features include triggered positive relay action; a quick release chassis; and a sensitivity which is claimed to be better than 1.0 p.f. under all conditions. The Major is fitted with C.S.A. approved terminal blocks and has a sheet metal weatherproof case. As is usual with the company's instruments of this type, fail-to-safe facilities are included. (*Fielden Electronics Ltd., Wythenshawe, Manchester.*)

Temperature and pressure controllers

Temperature and pressure controls —for warm air, steam, and hot water installations—can now be selected from a range of "on/off" and potentiometer-type modulating controllers available from Honeywell Controls

Fig. 4. The Honeywell Controls pressure-controller now available to cover the range 0 to 300 lb./sq. in. (Honeywell Controls Ltd.)

RECENT Equipment AND Accessories

Hydraulic materials handling system

Orders for the Babcock & Wilcox Ltd. "Hyjector" jet-pump, a water-operated ejector unit for pumping a mixture of solids and water through a transporting pipeline, have already been received from the Central Electricity Generating Board for installation in the ash- and dust-handling plants at Uskmouth "B," Aberthaw and Willington "B" power stations. Solids are transported by means of a jet of high-pressure water which issues from a converging nozzle at high velocity, entrains and mixes with the solids, and discharges the mixture through a diverging throat. The pressure energy of high-pressure water is completely converted to energy of motion by the jet nozzle. The complete lack of pressure beyond the jet nozzle permits merging of water and ash admitted through the suction inlet with the jet water issuing from the jet nozzle. The mixture passes through the diverging throat which reduces the high velocity and, at this point, converts the energy of motion back to pressure energy. This pressure energy is the force used to overcome the resistance due to pipe friction and static head. The solid material, when discharged from the storage hopper, falls into a small feed hopper in which a jet of high velocity water from an auxiliary nozzle feeds the material into the suction inlet of the "Hyjector." The material must be fed into the "Hyjector" under positive head and must not depend on the suction developed by the unit. Wear on the unit is minimised by (1) use of wear resistant materials; (2) use of few connecting joints within the equipment; (3) locating the high-pressure jet water nozzle tip out of the path of the material being transported, with the result that there is no interference with the free flow of solids, which prevents plugging and makes it unnecessary to back-wash the unit. The "Hyjector" may be assembled and dismantled easily. The inlet piece, throat and discharge piece are clamped together at each joint by four through-studs instead of bolt flanges. Babcock "Hyjectors" are available in four sizes, from 3-in. by 4-in. to 8-in. by 10-in. The smaller size is used for handling iron pyrites rejected by coal pulverisers, while the three larger sizes are generally used to handle boiler bottom ash and disintegrated slag. The maximum size of solids recommended (1¾-in. to 4-in.) are for average conditions in order to provide for the free and continuous passage of a number of pieces running concurrently. Maximum sizes of pieces are determined for special cases after all conditions are known. Before solid material is fed into the conveying system, provision is made to size it by means of a clinker grinder or by manually breaking oversize pieces on a grid. The quantity of solids that can be transported hydraulically through a pipeline depends upon the quantity of fluid/solid mixture flowing and the concentration of solids in the mixture. The quantity of fluid/solid mixture is fixed by the velocity of the mixture and internal diameter of the pipe. The total quantity of water required to operate a hydraulic materials-handling system is determined by the internal diameter of the pipe and by the desired pipeline velocity of the fluid/solid mixture. The total water required consists of that entering the suction inlet plus the high-pressure jet water. The water entering the suction inlet consists of the water used to discharge the solid material from the storage hopper and the water from the auxiliary feed nozzle. (*Babcock and Wilcox Ltd., Babcock House, 209, Euston Road, London, N.W.1.*)

Fig. 1. A model of the new "Hyjector" jet pump for pumping a mixture of solids and water through a transporting pipeline. (Babcock & Wilcox Ltd.)

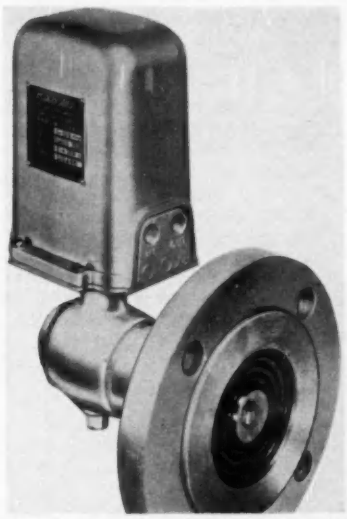
Heavy-duty small wheel grinder

The Airetool Manufacturing Co. have recently introduced a new air-powered production tool, the Model 400-G heavy-duty small wheel grinder. This lightweight tool has been designed specifically for general small wheel grinding on large dies, castings, patterns or other intricate construction. It is particularly useful for metal removal in precision die work, has many uses in production lines where speed and versatility of use are important. The tool is equipped with a positive lever throttle control for quick, safe starts and stops, and can also be provided with a button throttle if preferred. A further feature of the grinder is that it can be obtained in either collet chuck or spindle models for use with various grinding wheels or mounted accessories. An Airetool ball-bearing pneumatic motor operating at 19,000 r.p.m. is provided to drive the Model 400-G. The tool weighs only 1½-lb., and is 6½-in. long by 1½-in. dia. It has a ¼-in. collet chuck, or can be ordered with a ⅜-in. 24-thread spindle which will accommodate either a 1½-in. vitrified wheel or a 2-in. bonded wheel. (*The Airetool Manufacturing Co., Springfield, Ohio, U.S.A.*)

Liquid level transmitter

Foxboro-Yoxall Limited have recently added to their range of pneumatic transmitters a new instrument known as the type-13FA. It is a direct-mounted liquid level transmitter using the company's type-13A force-balance design to measure liquid level in open or closed vessels. It transmits an output air signal to standard 3-15 lb./sq. in. receiver recorders and controllers which may be locally or remotely mounted. The

sensing diaphragm is flange mounted to the side of the tank. This means that there are no process piping problems and the unit is thus particularly suited for the measurement of fluids of the viscous and slurry types. For open vessel measurement only the high-pressure side of the pressure measuring diaphragm and the raised serrated face of the cell flange are in contact with the process fluid. The low-pressure side of the diaphragm is vented to atmosphere. For closed



(Fig. 2, left). The new Foxboro-Yoxall direct-mounted liquid-level transmitter. (Foxboro-Yoxall Ltd.)

vessel measurement only an equalising leg is required. The twin diaphragm measuring element, liquid-filled and with a solid stainless steel core, is completely protected against accidental overrange. It covers the full range of the instrument—0-20 to 0-850-in. of water. Range changing is a simple matter of moving a range wheel up or down a range-rod fitted with a calibrated range scale. The instrument is suitable for use on pressures up to the rating A.S.A. 300 at 350 deg. F. maximum vessel temperature. The type-13FA is directly-mounted to the tank in any convenient position, vertically, horizontally or upside down. (*Foxboro-Yoxall Limited, Redhill, Surrey.*)

Dust exhausting and collecting unit

Among new products added to the Keith Blackman Ltd. "Tornado" range of fan engineering equipment is the T.2500 dust exhausting and collecting unit which has now been included in the "T" series units, six sizes of which are available for handling 250 to 2,500 cu. ft./min. of dust-laden air. The units are designed to safeguard machinery, improve working conditions and, thereby increase productivity by exhausting and collecting dust created by such machines as grinders, polishers and finishers. The T.2500 unit is the first to be fitted with a new "snap-action" mechanical shaking gear for dislodging fine dust trapped in the filters, the dust then dropping into a 5-cu. ft. dust tray at the foot of the unit. All units will in future be fitted with this device, with the exception of the T.250. The overall size of the new T.2500 is 6-ft. 6-in. high by 3-ft. wide by 3-ft. deep. It will serve

(Fig. 3, below). The new Keith Blackman T.2500 dust collecting and exhausting unit. (Keith Blackman Ltd.)

four reasonably spaced, double-ended grinding or polishing machines with 10-in. wheels, or a medium size scurfing or fettling booth. Keith Blackman "Tornado" high-efficiency, power-limiting fans together with the company's totally-enclosed motors are fitted to all units in the range. (*Keith Blackman Ltd., Mill Mead Road, London, N.17.*)

New level controller

In 1949 Fielden Electronics Ltd. produced a capacity operated level controller, which was given the trade name of Tektor. Recently a new and improved unit, the Tektor Major, has been made available, and a short note relating to this was included in a preview of the recent Instruments, Electronics and Automation Exhibition, published in the April 1958 issue of this journal. A more detailed description is given below. The Tektor Major consists essentially of a capacitance probe which is mounted in a predetermined position on the inside of the wall of the containing vessel. The probe is connected by coaxial cable to the instrument itself which can be mounted some distance away. In operation the proximity of the material in the container, with respect to the probe causes a change in capacitance. This change disturbs the balance of a capacitance bridge in the instrument and, at a predetermined level, operates a contactor relay, and lights an indicator lamp. The performance of the instrument is stated to be independent of cable length up to the specified maximum and a cable selector switch is fitted to enable the appropriate cable length to be provided for on site. Printed circuits are incorporated for reliability, and the Major has a control knob on the front of the chassis which enables the set-point also to be easily adjusted on site. Other features include triggered positive relay action; a quick release chassis; and a sensitivity which is claimed to be better than 1.0 p.f. under all conditions. The Major is fitted with C.S.A. approved terminal blocks and has a sheet metal weatherproof case. As is usual with the company's instruments of this type, fail-to-safe facilities are included. (*Fielden Electronics Ltd., Wythenshawe, Manchester.*)

Temperature and pressure controllers

Temperature and pressure controls —for warm air, steam, and hot water installations—can now be selected from a range of "on/off" and potentiometer-type modulating controllers available from Honeywell Controls

Fig. 4. The Honeywell Controls pressure-controller now available to cover the range 0 to 300 lb./sq. in. (Honeywell Controls Ltd.)

Ltd. Pressure-controllers, covering the range 0 to 300 lb./sq. in., are generally used as a direct controller of an automatic burner on steam or vapour-heating plants. These pressure instruments can also be used to control the pressures of air, liquids, and non-combustible gases. Variation in pressure is detected by the controller's bellows which can either actuate a switch or, for fully proportioning control, move a sliding contact across a potentiometer coil to position a modulating motor. Temperature controllers with a range of 0-700 deg. F., control temperatures in ducts, pipes, tanks, boilers and heat-exchangers. Temperature changes at the remote bulb are transmitted, as vapour pressure changes, by a capilliary tubing to a bellows in the instrument. The movement of the bellows operates a switch or, for fully-proportioning control, a potentiometer slider to position a modulating motor. (*Honeywell Controls Ltd., 1, Wadsworth Road, Perivale, Middlesex.*)

Vibration measurement

The self-contained, "type-1414" vibration indicator manufactured by Dawe Instruments Ltd. is used with a vibration pick-up of the inertia-operated crystal type delivering a voltage proportional to the acceleration of the object with which it is in contact. The instrument itself weighs 2¼-lb. and measures only 8¾-in. × 3¾-in. × 2¾-in. It consists of a variable resistive attenuator (providing six ranges in steps of approximately 3 : 1) followed by a high-gain amplifier feeding a direct-reading indicating meter. With this circuit, the meter gives a direct reading of peak acceleration up to the maximum value of 3,000 in. sec.^{2} (about 10 g). To measure the other two important characteristics of vibration, namely velocity and displacement, single- and double-integrating circuits are provided. By turning a selector knob, one or both of these integrating networks are inserted into the circuit before the amplifier, thus appropriately modifying the signal to the indicating meter. The same control knob has two further positions for checking the condition of the built-in h.t. and l.t. dry batteries against a red mark on the meter scale. To obtain a reading, the selector knob is set to the required parameter, the pick-up is held in contact with the object under investigation, and the attenuator knob is turned until the meter pointer takes up a reading. An 8-in. extension probe is supplied with the pick-up to make it possible to check vibration in locations which would otherwise not be accessible. (*Dawe Instruments Ltd., 99, Uxbridge Road, London, W.5.*)

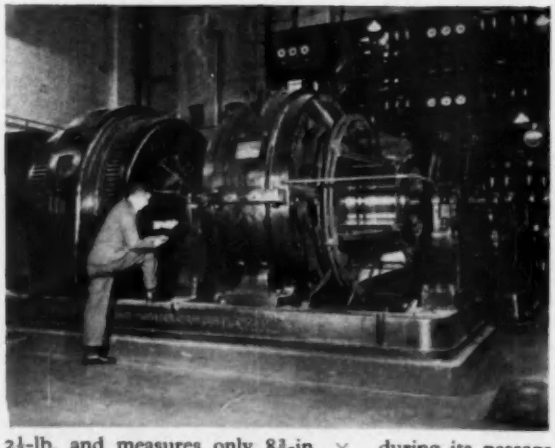


Fig. 5. Using the Dawe type-1414 vibration indicator to check dynamic balance and state of bearings on heavy electrical machinery. (Dawe Instruments Ltd.)

Heavy-duty blade mill

The largest blade mill ever made at the Erith works of The General Electric Co. Ltd. is now operating in the concentrating plant of The African Manganese Co. Ltd., Ghana, W. Africa. The mill, which has a capacity of 400-tons of minus 5-in. ore per hour, consists essentially of an 8-ft. dia. rotating cylinder, 24-ft. long, supported on eight rollers. Ore enters through a feed inlet at one end with about an equal weight of water. Rows of blades churn this up during its passage through the mill, so that it is discharged with all the clay disintegrated and the mineral scrubbed clean. The shell is constructed of 1-in. mild-steel plate in two sections, each 12-ft. long. Liners of chromium steel, 2-in. thick, protect the interior, including both ends, from wear. At the discharge end are radial scoops which lift the disintegrated ore pulp on to a heavy central deflector of manganese steel. Thence the pulp is directed into a discharge trommel with circumferential blades for moving it forward out of the mill. Round the shell are two roller paths of cast steel, 4-in. thick, with faces 20-in. wide. Each roller path runs on two pairs of 21-in. dia. rollers, and two thrust rollers are provided to keep the shell in position longitudinally. The mill is driven by a spur gear round the shell with a face width of 12-in. This engages with a spur pinion forged integral with its shaft. A flexible coupling with spring-type membranes as the driving media connects the pinion shaft with the output shaft of 10/1 reducing gear, which is automatically-cooled and lubricated. The input shaft of the gear is connected through a Vulcan-Sinclair scoop-controlled fluid coupling to a General Electric 500-V totally-enclosed, fan-cooled, squirrel-cage motor, running at 1,450 r.p.m., with an auto-transformer starter. The fluid coupling gives an infinitely variable speed of mill rotation up to a maximum of 18 r.p.m., and is also a useful adjunct for inspection and maintenance, as it can be used for inching the mill round to the positions required for servicing. Roller bearings are fitted throughout the mill. Lubrication is effected by hand-operated grease pump directly connected to each of the thirty bearings. The total weight of the blade mill is 80-tons. (*The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.*)

Automatic oil burner control

Photoelectronics (M.O.M.) Ltd. have introduced a new automatic oil burner control (type AB/FLC). This new unit provides automatic control of the lighting-up cycle for all types of burners and operates in conjunction with either a Fluestat or cadmium photo-electric cell to provide instantaneous flame-failure control, the sequence of operations being controlled by a synchronous motor driving suitable cams which operate micro-switches. The micro-switches actuate the ignition, oil-pump motor and lock-out, and on every revolution of the motor a check cycle ensures the correct operation of the electronic circuit. Contacts are supplied for switching either single-phase or three-phase motors. Different cams can be fitted to follow any sequence of operations whilst by changing the motor the overall programme can be varied to give an overall time from 30 sec. to 60 min. A typical control cycle would be :—ignition on for 10 sec., after which the oil-pump motor is energised and maintained for 15 to 30 sec. in order that the flame can be established, and by which time the photo-electric cell

will have seen the flame or the Fluestat will have changed over. The oil-pump relay will now be held in by the sensing element, the check cycle takes place, and the motor continues to the end of its cycle and then stops. Should flame-failure occur the motor will commence a new cycle and should the flame not be re-established by the end of the oil period the unit will lock-out and a warning lamp be illuminated. The unit is re-set from lock-out by depressing a re-set button ; the motor will then restart and continue the cycle through the purge period, which can be from 15 sec. to 5 min., to the end of the cycle when it will then automatically start a new cycle. (*Photoelectronics (M.O.M.) Ltd., Fotron Works, 63A, Kingston Road, London, S.W.19.*)

Following their close co-operation in the supply of complete instrumentation for four heavy-water research reactors, **Ekco Electronics Ltd.,** Ekco Works, Southend-on-Sea, and **George Kent Ltd.** are now offering their joint services for the contracting, engineering and manufacture of over-all instrumentation schemes for both power and research reactors. George Kent Ltd. are producing the physical instrumentation for various reactors, heat-exchangers and turbines, as well as recorders for nucleonic instrumentation. Ekco Electronics Ltd., with their extensive range of nucleonic control and health instrumentation and associated control circuitry, are able to make the joint coverage of the two companies the most complete at present available in the instrument sphere. By a close liaison, the two companies have established an extremely strong position in the nucleonic field, and they have already completed a number of major contracts at home and overseas. Their individual or combined resources are available for contracts of all sizes.

* * *

A heat-resisting bituminous paint manufactured by **Tretol Ltd.** is the firm's H.R. black enamel, which is designed to give protection against sulphurous fumes and acid condensates in temperatures up to 400 deg. F. It is claimed to possess excellent resistance to wet chemical corrosion in these conditions. This material has for many years been specified by local gas authorities for the protection of internal surfaces of asbestos cement flue pipes. It can also be used on the internal surfaces of concrete chimneys. This bituminous material has in many instances been found extremely successful in difficult industrial conditions where alternative types of coatings of considerably higher cost have proved inadequate. Direct application can be made to metal or concrete surfaces and no primer is needed. Full details of Tretol H.R. black enamel can be obtained from Tretol Ltd., manufacturers of paints and building products, The Hyde, London, N.W.9. Telephone : Colindale 7223.

* * *

It is with regret that we record the death recently of **Mr. G. A. S. Harvey,** president of G. A. Harvey & Co. (London) Ltd. Mr. Harvey, who was in his 74th year, was the son of the founder of the company. He was appointed assistant managing director in 1913 when the works were moved to the present site in Woolwich Road, Greenwich. Very soon after the move, Mr. Harvey became managing director, and on the death of his father in 1937, was appointed chairman and managing director, a position he occupied until his retirement from active participation in the business in 1956, when he was appointed president.

To mark the continuing expansion of their range of chlorinators, chemical feeders and other equipment, **Wallace & Tiernan Ltd.** showed a representative selection of their products at the International Water Supply Congress and Exhibition at Brussels recently. The chief item of interest on the stand was the V-Notch chlorinator, with its new method of gas flow control, which was shown linked up with residual control equipment for operation in conjunction with a sulphonator. In addition there were newly developed panel-type chlorinators—the P.A.-677 manufactured by the German company and the BA-678 made in England. Another product of the German company is the PA-690 volumetric dry feeder which was shown in view of the increasing interest in the application of coagulating chemicals in powder form. Proportioning pumps, for solution feeding, manufactured by E.C.D. Limited, an associate company, were also on display. From May 31st-June 8th, Wallace & Tiernan Ltd. also exhibited their equipment at the Achema Exhibition in Frankfurt.

* * *

We have received from **G. & J. Weir Ltd.,** Cathcart, Glasgow, S.4, a new publication (No. 171) which contains details of Weir steam turbines for constant or variable speed drives. These are supplied in vertical or horizontal designs, as direct or geared types, the standard range having outputs up to 1,000 b.h.p. with steam at 650 lb./sq. in. and 900 deg. F., back-pressure up to 35 lb./sq. in., and a speed range of up to 7,500 r.p.m. (direct) and 500-3,000 r.p.m. (geared). Special units can be made available with power outputs up to 2,500 b.h.p.

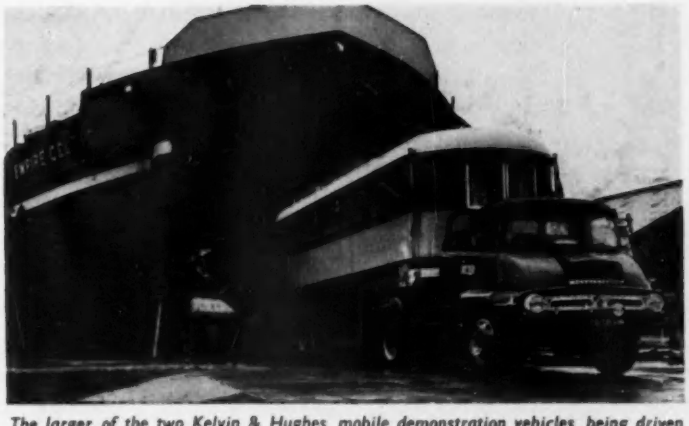
The Candy Filter Co. Ltd. announce that owing to the rapid expansion of the business of their Chemical Pump Division, it has become necessary to establish an entirely separate organisation. A company has, therefore, been formed, with the registered name of Metering Pumps Ltd., 21, The Mall, Ealing, London, W.5. Telephone No. Ealing 4024.

* * *

Technical Designs Ltd., 46, Brook Street, London, W.1, have appointed **Mr. P. B. Ward** as sales manager. Prior to this appointment, Mr. Ward was sales manager with Danite Hard Metals Ltd., Doncaster, and previously with Deloro Stellite, Birmingham.

KELVIN & HUGHES LTD.

Two mobile demonstration units forming the Kelvin Hughes exhibit at the Poznan Fair, which opened on June 8th, were shipped from Tilbury on June 2nd. They will be used to show industrial and marine instruments manufactured by Kelvin & Hughes Ltd., and the largest of the two units will, after the Poznan Fair, make a tour lasting four months of Hungary, Czechoslovakia, Rumania and Yugoslavia before returning home through Italy and Germany. This is a 9½-ton articulated vehicle carrying special lighting fixtures for hospital operating theatres, electronic instruments for the detection of flaws in metal, equipment for promoting greater boiler efficiency and a cine projector. The second unit, a caravan towed by a Land-Rover, is fitted with marine instruments, and after the fair will call at Polish, Western German and Belgian ports. It carries equipment for the horizontal and vertical detection of fish, as well as modern marine radar.



The larger of the two Kelvin & Hughes mobile demonstration vehicles being driven into the hold of the "Empire Celtic" at Tilbury for shipment to Europe.

PHOSPHATES
in boiler water treatment

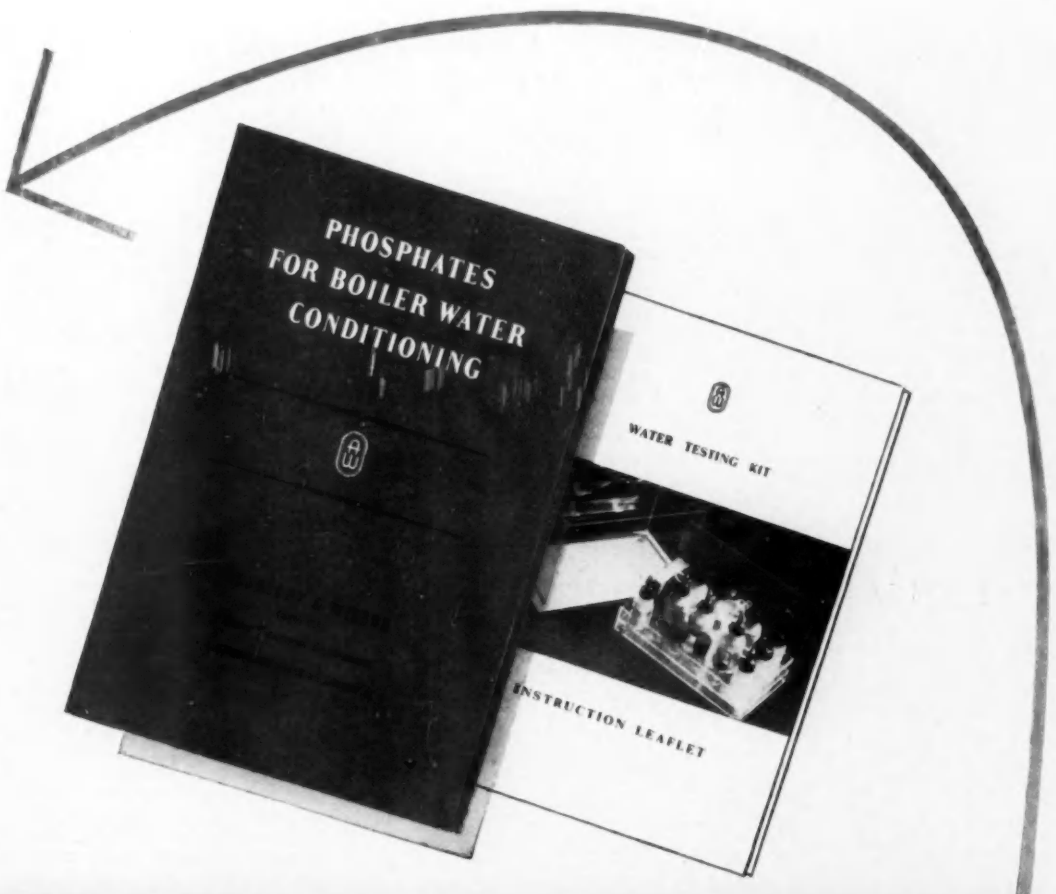
PHOSPHATE CONDITIONING

is thoroughly established as the most satisfactory method of preventing calcium and magnesium scale deposits in all types of boilers. Such deposits cannot form when a phosphate reserve and correct alkalinity conditions are continuously maintained in the boiler water.

Indispensable at high pressures, phosphate conditioning at low pressures leads to such improvements in results that it is generally preferred to other forms of treatment.

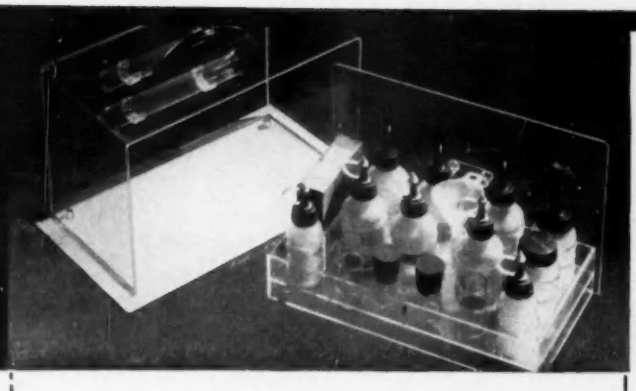
Ask your supplier of boiler conditioning chemicals how little you would have to pay to be sure your boiler is scale-free *all the time.*

TPW 518



CONTROL
IS
SIMPLE

Control of
PHOSPHATE CONDITIONING and
testing of raw and softened
waters is a simple matter
using Albright & Wilson's
NEW WATER TESTING KIT



For booklet on Boiler Water Conditioning and leaflet describing Albright & Wilson's Water Testing Kit please complete coupon and post to:

ALBRIGHT & WILSON (MFG) LTD

Water Treatment Department,
1 Knightsbridge Green
London SW1
Tel: Kensington 3422

Please send me your booklet on BOILER WATER CONDITIONING WITH PHOSPHATES and leaflet on WATER TESTING KIT:

NAME .....

POSITION IN COMPANY .....

ADDRESS .....

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Water-tube boiler

This invention is concerned with steam generators of a design in which the walls and roof of the combustion chamber are formed by water-tubes which are connected in a natural circulation system including a steam drum, and wherein an open-pass is provided for the products of combustion from near the upper end of the combustion chamber downwards to the lower end of a convection-pass through which the flue gases rise. In Fig. 1 the wall of the combustion chamber (1) is formed at the front by plain or finned water tubes (2). These tubes extend from a header (3) upwards, and then across to a steam drum (5), the tubes thus forming the roof (4). The sides of the combustion chamber are formed by water tubes (6) which extend between lower and upper headers (7 and 8), connected to the drum (5), as also is the header (3). The rear wall of the chamber (1) is formed also by water tubes (9) which likewise define one wall of an open-pass (14). The other wall of the open pass is defined by the row of tubes (12) of a convection section. The tubes (9) are alternately set off at their upper ends as indicated at (9^1) to allow the combustion gases to pass from the chamber (1) into the upper end of the open pass (14), the lower end of which opens into a space (15), and then to the convection section (S). The tubes (9 and 12) are connected direct to the steam drum (5). The lower ends of the tubes (9) are taken below the floor (50) of the combustion chamber, and are there connected to a header (51) below the header (3) and, like that header, connected by a pipe (52) to the steam drum (5). This arrangement is intended for use especially in oil-fired furnaces ; in the case of coal-fired furnaces the tubes (9) would terminate at a lower header at the rear of the furnace, this header being usually constituted by an extension of the headers (10). In the particular construction shown in Fig. 1, the open pass (14) has a superheater (40) disposed across part of its width. *British Patent No. 794,046 issued to Bouellat Engineering Ltd. and F. W. Bauer.* (*Patent of Addition to No. 734,262.*) *Complete specification published April 30th, 1958.*

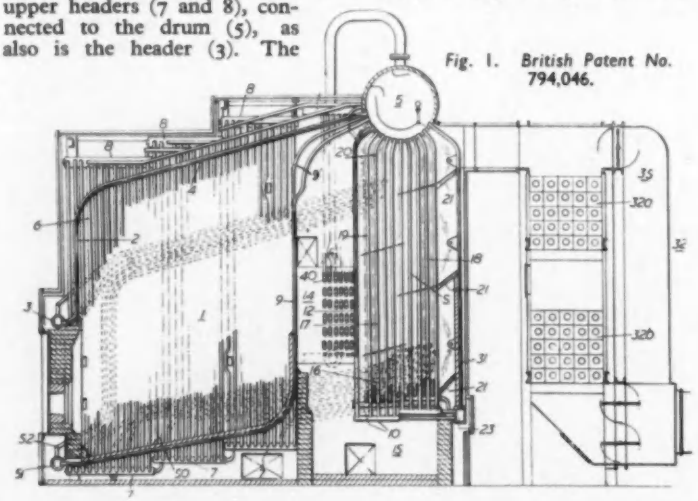


Fig. 1. *British Patent No. 794,046.*

Nuclear reactor plant

This invention relates to nuclear reactors and to an improved method of their operation. There are reactors in which a gaseous coolant, more particularly carbon-dioxide, is circulated in heat-exchange relationship with the core. During the fission process, small quantities of radioactive gases are evolved by the fuel, and such gases obviously tend to interfere with the efficient operation of the reactor. Particular difficulty may arise from the production of xenon from uranium. The gases may be confined by canning the fuel elements, but the operating temperature is then limited by the maximum temperature at which the cans will withstand the stresses involved. The method of operating a nuclear reactor in accordance with this particular invention includes utilising in a core fuel unprovided with gas-tight enclosing means, circulating gaseous coolant in a closed circuit and in heat-exchange relationship with the core. Undesirable gaseous products evolved by the fuel are removed from the coolant by a process which includes separating the coolant and the products through the action of a solvent which exerts a selective dissolving action. Thus, for example, xenon may be separated from the coolant by the use of a solvent in which the coolant dissolves if at all only to a small extent. In Fig. 2, a reactor core including a graphite moderator (2) is enclosed within a reactor pressure vessel (1). Rods (5) of fissile material such as uranium containing material unprovided with gas-tight cans or sheaths are positioned in channels (3) in the moderator by suitable externally-operated means (4). Provision is made for circulating a gaseous coolant, such as carbon-dioxide upwardly through the channels (3) and through a tubular heat-exchanger (7) in the form of a boiler. The boiler comprises a pressure-vessel (17) with hemispherical ends, and fitted with tube plates (8 and 9) having fluid-tight connections with the pressure-vessel shell. Tubes (10) extend between the tube-plates, and the space within one of the hemispherical ends is divided by a partition (11) so that the coolant may be caused to flow in a U-shaped path between chambers (12 and 13) on opposite sides of the partition through one group of the tubes (10), the space within the other of the hemispherical ends and the remainder of the tubes (10). An outlet from an upper region of the pressure vessel (1) is connected by a pipe-line (6) with the chamber (12), whilst the chamber (13) is connected by a pipe-line (14) containing a circulating pump (15) and a

throttling valve (16) with a lower region of the pressure vessel (1). A pump (19) is arranged to feed water through a pipe-line (20) fitted with a stop-valve (21) into the space (18) between the tube plates and to take steam from the pressure vessel (17) through pipe-line (22) which is fitted with stop-valve (23). In the operation of the nuclear reactor, the gas spaces of vessels (1 and 7) and pipe-lines (6 and 14) are filled with the coolant which is under a certain pressure, and which is circulated in the closed circuit by the pump (15). The coolant takes up the heat generated in the reactor core and transmits it by way of the tubes (10) in space (18) to the water to be evaporated. By adjustment of the throttling valve (16) a part of the coolant stream may be forced through line (26), this part being further cooled in surface heat-exchanger (28) and discharged through the perforated pipe (30) into the vessel (31). When the coolant is carbon-dioxide, the most suitable solvent is water. Carbon-dioxide is thereby dissolved in the water within the vessel (31), whereas the insoluble xenon together with a part of the carbon-dioxide is blown off through valve (39). When the operation is continuous, water with carbon-dioxide in solution is passed through the throttling valve into vessel (32), which has a lower internal pressure. Degasification of the solvent takes place in the vessel (32), the xenon remaining in the vessel (31) until it is blown off. The water is returned to vessel (31) by the pump (36). Water vapour has the property of slowing down neutrons, but its presence in the gas coolant may be dangerous owing to its corrosive action. The carbon-dioxide liberated is, therefore, returned by compressor (41) to the closed circuit by way of the freezing plant (43), which effects removal of water vapour by cooling it below the freezing point. To subject only part of the gas in circulation to the purifying process is sufficient, since a certain enrichment in xenon is permissible. *British Patent No. 794,329 issued to Babcock & Wilcox Ltd. Complete specification published April 30th, 1958.*

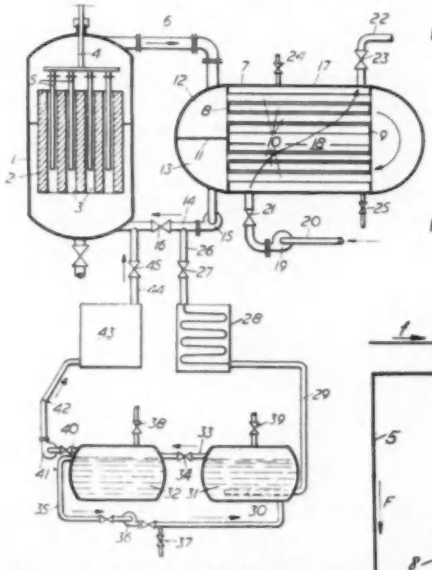


Fig. 2 (left). *British Patent No. 794,329.*

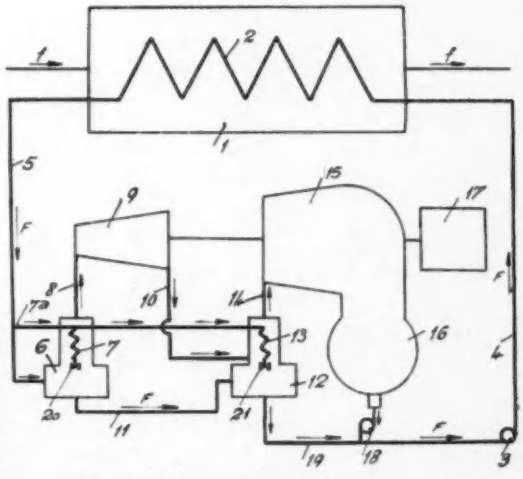


Fig. 3 (below). *British Patent No. 795,007.*

Superheated steam production by nuclear fission

In the case of a nuclear reactor, the evolution of heat is so considerable that it is necessary to cool the space inside which the reaction is performed, and the fluid employed for cooling carries along with it the heat to be recovered. If the temperature of the fluid is moderately high, an efficient recovery can be obtained only by using a condensable fluid such as, e.g., steam. The production of steam can be performed by inserting in the path followed by the hot fluid a steam generator including a steam superheater, a vaporising tube-bundle and a water-heating heat-exchanger. It has already been proposed to insert in the path of the fluid a number of steam generators through which the hot fluid passes in succession, and which produce steam at different pressures; the volumes of steam produced by these different generators feed either separate turbines or suitable stages of the same turbine. This solution leads to a double drawback; on the one hand it entails considerable losses of head, both in the circuit of the hot fluid and in that of the steam produced; on the other hand, it requires the presence of intricate conduit arrangements of which some are filled with steam, which results generally in the necessity of repeated maintenance work, the execution of which may prove to be difficult, particularly when the heating fluid is radio-active. In the plant shown diagrammatically in Fig. 3, the fluid, the heat of which is to be recovered, flows through the channel (1), inside which is inserted the heat-exchanger (2) fed with water by the pump (3) through the pipe (4). The hot water produced is sent out through the pipe (5) into the first evaporator (6), inside which it is partly vaporised. The steam produced is superheated by a heat-exchanger (7) fed with hot water tapped off the pipe (5) at (7a). A pipe (8) feeds the superheated steam into the input of the high-pressure turbine (9). A pipe (10) is fed with steam at the output of the turbine (9) with a view to mixing the steam with the saturated steam produced inside the second evaporator (12) fed through the pipe (11) with the residuary water remaining in the evaporator (6). A heat-exchanger (13) fed in parallel with the heat-exchanger (7) effects the superheating of this mixture of the two steam fractions before the mixture passes into the low-pressure turbine (15) which is coupled simultaneously with the high-pressure turbine to the alternator (17). The steam expands in the turbine (15) down to the pressure prevailing inside the turbine condenser (16). An extraction pump (18) delivers the condensate into the pipe (19) passing out of the evaporator (12), in which pipe the condensate mixes with the residuary water remaining inside the evaporator (12). The mixture is drawn in afterwards by the pump (3) which is located beyond the point of mixture between the condensate and the residuary

water. The valves (20 and 21) allow adjustment of the amount of superheating. Obviously, the turbine may be of single cylinder construction instead of comprising two separate cylinders. *British Patent No. 795,007 issued to Electricite de France—Service National. Complete specification published May 14th, 1958.*

Furnace chamber with secondary air supply

The invention to which this patent refers relates to furnace chambers with secondary-air supplies, and in particular to furnace chambers arranged for stoker-firing with over-fire or secondary-air. In the operation of a stoker-fired boiler furnace, jets of secondary-air discharged above the burning fuel may be employed in order to promote both turbulence and rapid and complete combustion within the furnace chamber. In practice, the difficulty sometimes occurs that slag deposits build up upon the furnace chamber wall surface adjacent the secondary-air outlets. It is thought that the jets of secondary-air directed in a forward direction from the outlets induce a rearward movement of the flame, with the result that particles of sticky or molten slag impinge upon the furnace chamber wall surface over an area above the outlets. However this may be, deposits are liable to form which interfere with the correct direction and flow rate of the jets of secondary-air projected into the furnace chamber, with the result that imperfect combustion in the furnace chamber occurs. As a consequence of delayed combustion and abnormally high temperatures adjacent the convection heat-exchanger tube surfaces in the gas flow path leading from the furnace chamber, serious fouling of those surfaces may occur. One object of this particular invention is to obviate or lessen the danger of interference by slag deposits with a proper discharge of secondary-air into a furnace chamber. In Fig. 4 a furnace chamber (1) is provided with a combustion space (5) arranged to be fired with fuel (3) supplied from a fuel-hopper (4) to a travelling-grate (2). Below the grate is an air-passage (11) for the supply of combustion or primary-air to the furnace chamber. The grate is arranged to discharge ash, after combustion of the fuel, into an ash-pit (6) formed below the grate at an end of it remote from the fuel hopper (4). The furnace chamber is provided with a front-wall (7) and a rear-wall (8) of firebrick formed with respective arches (9 and 10). In each of the walls (7 and 8), immediately above the respective arches, are provided means for the supply of over-fire or secondary-air to the furnace chamber, comprising respective rows of slightly downwardly inclined air-discharge ducts or nozzles (14 and 15). The row of ducts associated with the front arch (9) is arranged to be supplied with air from an air supply conduit (12) while the row associated with the rear arch (10) is arranged to be supplied from an air-supply conduit (13). Suitable means are provided for effective control of the stream of secondary-air. Each secondary-air discharge duct is provided at its outer end with a nozzle including deflecting means for directing some of the secondary-air over the furnace chamber wall surface, as is shown by the broken lines (40), whilst the remainder of the secondary-air is discharged as a jet into the combustion chamber as is shown by the broken lines (39). *British Patent No. 795,252 issued to Babcock & Wilcox Limited. Complete specification published May 21st, 1958.*

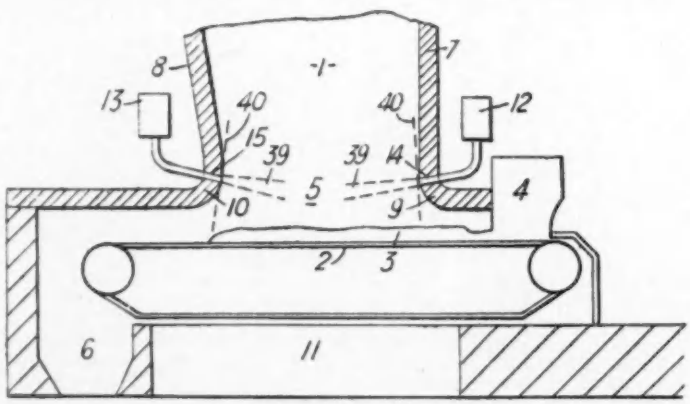


Fig. 4. British Patent No. 795,252.

Boiling water nuclear reactor

This invention relates to nuclear reactors and in particular to boiling water reactors. It is possible to construct a light or heavy water-cooled reactor such that the coolant can be allowed to boil, thus generating steam directly for use in steam turbines. However, it has been found that the fluctuation of effective coolant density which occurs because of steam voidage during ebullition causes the power output of the reactor to vary within limits since the coolant functions also as a moderator. An object of this invention is to provide a boiling reactor in which the steam voidage in the core of the reactor is virtually constant thus ensuring a constant power working level. According to the specification, the nuclear reactor comprises fuel elements of such shape and dimensions as to provide a smooth continuous surface, a further continuous surface closely adjacent to this surface to define a passage capable of supporting a climbing film system when the reactor is in operation, and means for feeding cooling liquid to the lower end of the passage at such a pressure head and feed rate that a climbing film system is set up. In Fig. 5 a number of circular-section coolant tubes (1) are arranged in the form of a calandria. The tubes (1) are arranged vertically inside a pressure-shell (2) with the lower ends (3) of the tubes (1) fitting into holes in a plate (5) which is arranged horizontally and extends completely across the cross-section of the pressure shell (2) so as to define two compartments (6 and 7) in the shell (2.) The compartment (6) contains the fuel

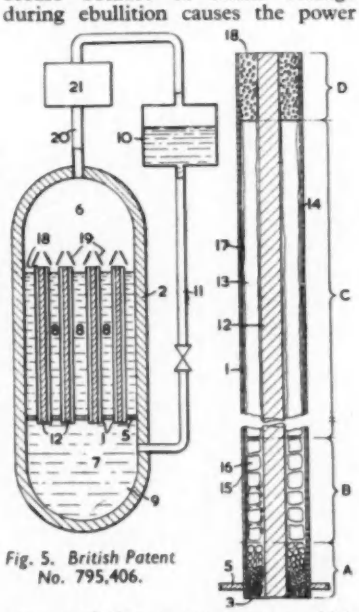
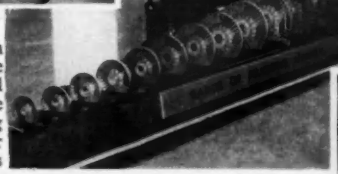
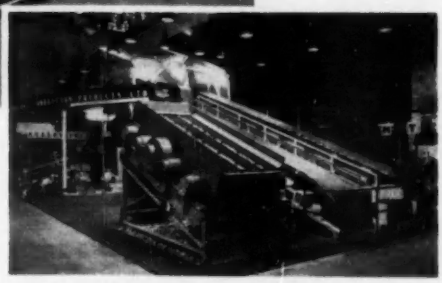


Fig. 5. British Patent No. 795,406.

coolant tubes (1) the space surrounding these tubes being filled with the bulk of the moderator liquid (8). The compartment (7) below the ends of the coolant tubes (1) is filled with coolant liquid (9) which is supplied by means of a header tank (10) connected with the compartment (7) by a feed tube (11). In the case of the example shown, the coolant liquid is similar to the moderator liquid. The fuel elements are contained inside the coolant tubes (1), each element taking the form of a single circular-sectioned rod (12) situated coaxially inside each coolant tube (1) so as to define an annular space (13). In accordance with known practice, each element comprises fissile material canned in corrosion resistant metal. Coolant liquid enters the end (3) of the tube from the compartment (7) at a predetermined pressure head and feed rate, and a thin film of evaporating coolant liquid climbs upwards over the surface of the heat-generating fuel element (12) and the inner surface (14) of the coolant tube (1). This action results from the drag of the high-velocity vapour stream in the space (13) between the fuel element (12) and the coolant tube (1). *British Patent No. 795,406 issued to United Kingdom Atomic Energy Authority. Complete specification published May 21st, 1958.*

MECHANICAL HANDLING EXHIBITION





Three of the stands at the Mechanical Handling Exhibition held at Earls Court, London, a few weeks ago. (Left). Babcock & Wilcox Ltd. (Centre). Fluidrive Engineering Co. Ltd. (Below). International Combustion Products Ltd.

Babcock & Wilcox Ltd. have been awarded the contract of a total value approaching £1-million, by the Central Electricity Generating Board, for the complete coal, ash and dust-handling installation for the new 720-MW power station at Northfleet, Kent. This handling installation will serve ultimately a total of six pulverised-coal fired boilers, each supplying steam to a 120-MW turbo-alternator. The coal plant, with a capacity of 1,600 tons/hr., will handle the seaborne coal from the Thames quayside, via belt-conveyors, to the boiler house or out to the coal store. The dust-handling system, capable of dealing with 210 tons/hr., will convey the dust from the dust-collection points over a distance of 2,600-ft. to the storage bunkers, for disposal.

* * *

The Central Electricity Generating Board are to make application to the Ministry of Power and the Local Planning Authority for consent to develop a site at Dungeness for their fifth nuclear power station. Investigation of the site, which is immediately west of the lighthouse near the tip of the Dungeness promontory, has shown that it is a very suitable one upon which a nuclear power station could be constructed. Deep water is available close in shore, providing exceptional facilities for the vast quantities of cooling-water required, and trial bores have shown that the foundations are capable of supporting heavy reactors and associated plant. The site consists of shingle and no agricultural land is involved. The proposed station would have an output capacity of 500-550-MW and space would be left on the site for further development. It would be connected to the 275 kV transmission system which is already to be brought to Lydd to interconnect, with the projected Cross Channel cable, now agreed upon.

Film Cooling Towers (1925) Ltd. have been informed by the Central Electricity Generating Board that their tender for four natural-draught cooling towers for Rugeley generating station, Staffordshire, has been accepted. The value of the contract is somewhat in excess of £750,000 and will be carried out in collaboration with J. L. Kier & Co. Ltd.

* * *

Mr. Peter H. Jackson, M.C., has been appointed home sales manager of the Lancashire Dynamo Group which he has served for more than twenty years. Mr. Jackson joined the Trafford Park Works of Lancashire Dynamo & Crypto Ltd. in 1936 as an assistant engineer in the service department, after initial training with British Electrical Repairs Ltd. During the war he served with the Royal Artillery in France and with the Royal Horse Artillery and Combined Operations in the Middle East. He returned to Trafford Park in March, 1946, and after a period in the estimating department he took up duties in the company's Manchester sales office. In 1951 he joined the London office staff where he specialised in the supply of equipment to power stations. When the Lancashire Dynamo Group's new selling arrangements came into operation in July last year, Mr. Jackson was appointed an assistant sales manager of the Group.

* * *

Hi-Dri paper towelling, manufactured by **Kimberly-Clark Ltd.,** 11, Grosvenor Gardens, London, S.W.1, is widely used today as a more hygienic, economical and efficient method of drying the hands and face, and during the past two or three years many new and completely different applications have been discovered and developed. For example, in engineering shops, manufacturing plants, printers, etc., Hi-Dri towelling is now used as a replacement for rags and wipers, being particularly suitable for this purpose as it can be used equally well wet or dry, will quickly absorb oil or water and will not fluff or lint. For this type of application double-width towelling is available, supplied in rolls 18-in. wide by 250-ft. in length.

CORRECTION

In a note published in the May, 1958, issue of this journal relating to an agreement recently concluded between Marshall, Sons & Co. Ltd., Gainsborough and the Cleaver-Brooks Co. of America, it was stated that Cleaver-Brooks claimed to have manufactured during the past year 35 per cent. of all the "packaged" fire-tube units "in the United Kingdom." This, of course, should have read, "in the United States."

NOTES Personal AND Industrial

Sir Josiah Eccles, M.Inst.C.E., M.I.Mech.E., M.I.E.E., has accepted the invitation of the Association of Supervising Electrical Engineers to succeed **Sir Harold Bishop,** C.B.E., F.C.G.I., M.I.Mech.E., M.I.E.E., as president.

* * *

After a long association with James Ferguson & Munro Ltd., **Evershed & Vignoles Ltd.** have decided, as a matter of policy, to terminate the agency and have direct representation in Scotland. The Scottish area office at 13, Rutland Street, Edinburgh 1 (telephone No. Fountainbridge 3058), is under the management of **Mr. R. M. Wardrop,** B.Sc. Joining the General Electric Co. in 1946, Mr. Wardrop spent the following seven years at their research laboratories at North Wembley on a variety of research and development projects. In 1953 he became assistant to the technical director of a company of scientific instrument manufacturers and in 1955 joined Evershed & Vignoles Ltd. as an instrument engineer.

* * *

Mr. H. Watson-Jones has been appointed managing director Richardsons Westgarth (Hartlepool) Ltd. and elected to the board of the parent company—Richardsons Westgarth & Co. Ltd. **Mr. T. P. Everett,** hitherto managing director at Hartlepool, has become executive director of Richardsons Westgarth & Co. Ltd. on atomic business based at London with **Mr. Harry Fothergill,** the company's consultant on atomic affairs. **Mr. J. O. M. Fisher** has relinquished the managing directorship at the Humber Graving Dock & Engineering Co. Ltd. (a subsidiary of Richardsons Westgarth) on reaching retirement age, but will continue to be a director. **Mr. A. A. E. Wise,** at present works director, becomes managing director.

* * *

As chief executive, Chemicals Division, British Oxygen, **Dr. R. F. Goldstein,** in addition to being managing director of British Oxygen Chemicals Ltd., is now also managing director of Carbide Industries Ltd., and a director of Odda Smelteverk.

* * *

It is with regret that we record the recent death of **Major Frank H. Bramwell,** B.Sc., F.C.G.I., D.I.C., etc., a director since April, 1949, of The Power-Gas Corporation Limited and Ashmore, Benson, Pease & Co. Ltd. Major Bramwell spent most of his working life with Imperial Chemical Industries Limited, the latter part as chief engineer of their General Chemicals Division.

* * *

Crofts (Engineers) Holdings Limited announce that **Mr. F. O. Ackroyd,** A.M.I.Mech.E., A.M.I.Prod.E., has been appointed to the board of Crofts (Engineers) Ltd., Thornbury, Bradford, Yorks.

Mr. P. H. Dunn, M.A., who, for the past four years has been the New York representative of Babcock & Wilcox Ltd., has returned to the company's head office in London to take up the appointment of assistant sales manager. **Mr. T. S. Blackadder** has been appointed representative of the company in New York. Mr. Dunn joined Babcock & Wilcox Ltd. as a student apprentice in 1939, subsequently going up to Cambridge where he obtained his degree in 1942. He served with the Royal Air Force as engineer officer from 1941-1946, then returning to Babcock & Wilcox for post-graduate training. In 1949, he joined the company's project engineering department. Mr. Dunn was appointed to the New York office in 1942, and became the company's representative in that city in 1954.

* * *

The United Steel Companies Ltd. announce that **Lt.-Cmdr. G. W. Wells,** D.L., at present managing director (engineering works), has been appointed managing director (production) responsible to the general managing director, Mr. A. J. Peech. Commander Wells will continue to hold the position of general manager of Appleby-Frodingham Steel Co., Scunthorpe, a branch of United Steel.

* * *

Mr. Arthur Makin, director and secretary Marshall Sons & Co. Ltd., Gainsborough, and director of a number of its subsidiary and associated companies, has resigned these appointments with effect as from June 30th, 1958. Mr. Makin's experience will not be entirely lost to the company and his services will be retained in an advisory capacity. **Mr. F. J. Wallace,** F.C.I.S., who has assisted Mr. Makin for a number of years has been appointed secretary of Marshall Sons & Co. Ltd., with effect on and from July 1st, 1958.

* * *

Mr. G. R. Lewis, B.Sc.(Eng.), A.M.I.Mech.E., M.I.E.E., has been appointed managing director of Crompton Parkinson (Doncaster) Ltd. Mr. Lewis joined the company in 1935 as a contracts engineer and from 1944-1949 was the company's chief service engineer. In 1949 he became general manager of the Young Accumulator Co. Ltd., Newport, Mon, and in 1954 was appointed general manager of Crompton Parkinson (Doncaster) Ltd.

* * *

Mr. J. E. Clark has been appointed manager of the Midlands District for British Oxygen Gases Limited. He has succeeded **Mr. J. G. Williams,** who has retired from the Company's service after 46 years.

* * *

Mr. S. F. Smith has been appointed sales manager of the Industrial Instruments Division of Firth Cleveland Instruments Ltd., Treforest, Glamorgan.

Ferranti Ltd. announce that **Mr. K. Ripley** has been appointed to succeed **Mr. Frank Hope** as chief test engineer, transformer department. Mr. Hope has retired after forty-six years' service with the company.

* * *

Mr. R. S. Lock has been appointed secretary of A. Reyrolle & Co. Ltd., in succession to Mr. G. J. Dodgson, who retired on May 31st.

* * *

G.W.B. Furnaces Ltd., Dudley, Worcs, announce that **Mr. G. L. Johnson,** A.M.I.H.V.E., has been appointed to represent them for the sale of Powermaster packaged automatic oil-fired boilers for the Midlands area. Mr. Johnson may be contacted at 25, Beaumont Road, Bournville, Birmingham, 30. Telephone Kings Norton 3392.

* * *

We have received from **G. & J. Weir Ltd.,** Cathcart, Glasgow, S.4, a new publication (No. 172) dealing with the "Robot" two-element boiler feed regulator. This unit is recommended for all water-tube boilers, and by complementary operation in the steam and water circuits of a boiler, regulates the supply of feedwater to replace that actually evaporated to meet the steam demand, and gives extremely accurate governing of the feed flow without delicate relay mechanisms.

* * *

The Birmingham Branch of **The English Electric Company Ltd.** has been moved from 75, New Street, to larger premises at Pitmaston, Moseley, Birmingham, 13 (telephone SOUth 4021/5). The Domestic Appliance Sales section is also located in the new premises, but the Appliance Service Depot remains at 175, Tennant Street, Birmingham, 15 (telephone MIDland 2803).

* * *

Honeywell-Brown Ltd. has changed its name to **Honeywell Controls Limited.** All head office departments and the London branch office have moved from Perivale to a new building in Greenford—Ruislip Road East, Greenford, Middlesex (telephone Waxlow 2333). The new name identified the company with its range of products—instrumentation, heating and air-conditioning controls, micro switches—and lines up with the names adopted by most overseas affiliates of the company.

* * *

The 1958 **Industrial Fuel Efficiency Exhibition** will be held at Olympia, London, from September 24th to October 3rd. In addition to the Exhibition, a series of conferences have been arranged by the Institute of Fuel and a programme will soon be available. The organisers are Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester, from whom particulars of stand space and other relevant details can be obtained.

Don't let the Clean Air Act outlaw you with smoke like this!
One thing is certain—with Ruston Horizontal Thermax
boiler plant you are truly in the clear!
Clean Air and steam raising efficiency go together
with Ruston Thermax boilers—boilers which radically
cut fuel costs and quickly recover capital outlay.
Rustons came first with the three-pass wet back
boiler—and still do!

THE MOST EFFICIENT SHELL-TYPE BOILER ON THE MARKET

RUSTON **HORIZONTAL THERMAX BOILERS**
evaporations up to 17,500 lb. per hour.

Write for illustrated catalogue, publication 8808X.

RUSTON & HORNSBY LTD · LINCOLN ENGLAND

PEABODY

HT

COMBINED BURNER

FOR OIL, GAS AND COAL WITH POSITIVE FLAME SHAPE CONTROL.

FOR A STEAM OUTPUT TO 150,000 lbs. per hr. PER BURNER

PEABODY GAS SCRUBBERS for Dust Removal, Gas Cleaning, Product Recovery, Fume and Mist Removal, Absorption, Stripping and Pollution Prevention.

PEABODY AIR HEATERS for Spray Drying, Rotary Drying, Calcining, Kilning, Flash Drying, Acid Concentration and Catalytic Reforming.

PEABODY

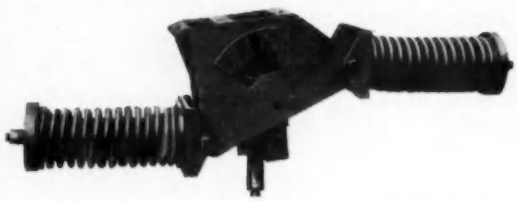
REGD. TRADE MARK

PEABODY LIMITED, PEABODY HOUSE, 300, VAUXHALL BRIDGE ROAD, LONDON, S.W.1. Telephone VICTORIA 9811/7

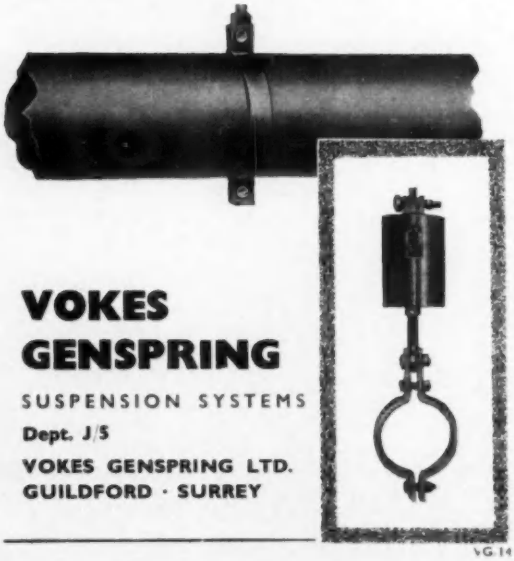
AGENTS IN MANY FOREIGN COUNTRIES
PEABODY ENGINEERING CORPORATION, NEW YORK 16

SAFE
SECURE SUPPORTS

Flexible Pre-Engineered Pipe Hanging



Piping that moves may well give rise to weight transfer and dangerous stresses at terminal points. Some high temperature pipes need complete support throughout their range of movement and to control vibration, while others need only limited control of vertical movement. In both instances the support provided must be correctly related to the stresses. Scientifically designed and constructed VOKES GENSPRING Suspension systems keep all such stresses safely under control. For uniform support VOKES GENSPRING CONSTANT SUPPORT HANGERS accurately balance the weight of the pipe, allow free non-resonant movement in all "hot" and "cold" positions, so eliminating weight-stress. Made to support loads of up to 30,000 pounds with travels up to 12", they simplify piping design and give the best possible protection to costly equipment. Designed to control vertical movement, VOKES GENSPRING VARIABLE SUPPORT HANGERS (shown below) give a variation of only 4½% of rated capacity per ½" of deflection. They provide a safe and convenient method of support, they are easily installed and may be moved at will for use in alternative positions. Various types are available including special adaptations for low headroom. If you have pipe suspension troubles send for the two Vokes Genspring Catalogues. They give full details of each method and will help you to select the type of suspension most suitable for your particular requirements.



VOKES GENSPRING

SUSPENSION SYSTEMS

Dept. J/5

VOKES GENSPRING LTD.
GUILDFORD · SURREY

VG.14

GORDON

LEADERS IN DESIGN OF AUTOMATIC BOILER CONTROL SYSTEMS

SINCE

1927

WHEN THEY INSTALLED THE FIRST FULLY AUTOMATIC CONTROL ON BOILERS IN THE UNITED KINGDOM

NOW IN

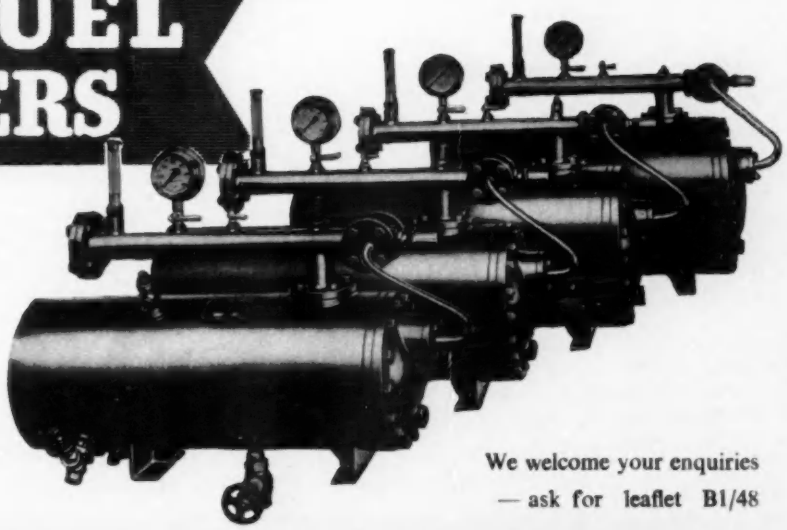
1958

THEY ARE AGAIN THE FIRST TO INSTALL A *PNEUMATIC* CONTROL SYSTEM ON A BENSON BOILER, THE FIRST BOILER OF THIS TYPE TO BE INSTALLED IN HOLLAND

JAMES GORDON & CO. LTD., DALSTON GARDENS, STANMORE, MIDDLESEX (WORDSWORTH 3631)

A MEMBER OF THE ELLIOTT-AUTOMATION GROUP

OIL FUEL HEATERS

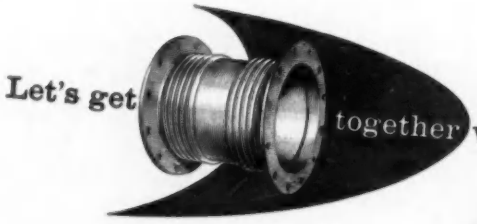


by Caird & Rayner Ltd., for all grades of Fuel Oil and Creosote Pitch. Standard sizes to deal with 10 to 2,000 gallons per hour using Steam or High Pressure Hot Water as heating media.

We welcome your enquiries — ask for leaflet B1/48

Caird & Rayner LTD

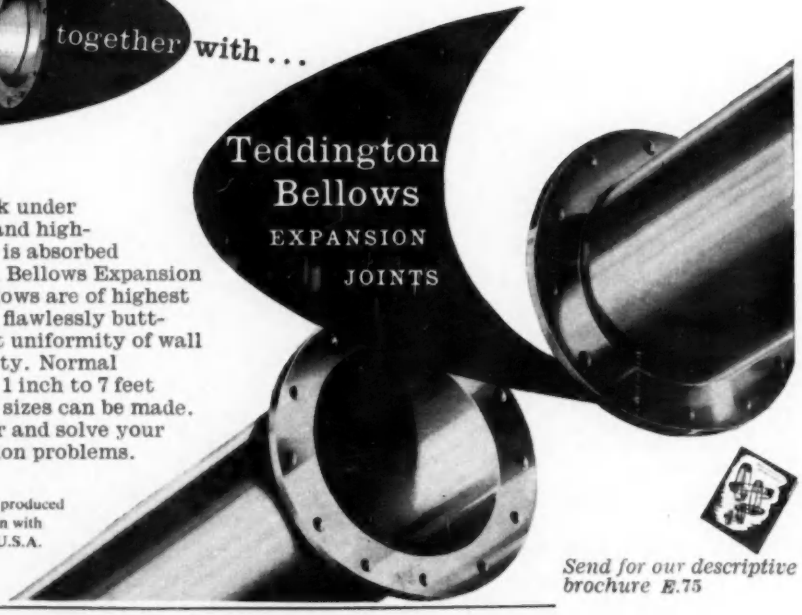
777 COMMERCIAL ROAD, LONDON, E.14. TELEPHONE EAST 3216 (31 lines) TELEGRAMS VAPORIZE LONDON



Teddington Bellows
EXPANSION JOINTS

MOVEMENT of pipe work under modern high-pressure and high-temperature conditions is absorbed efficiently by Teddington Bellows Expansion Joints. Teddington Bellows are of highest quality stainless steel, flawlessly butt-welded to ensure perfect uniformity of wall for maximum durability. Normal production ranges from 1 inch to 7 feet diameters and larger sizes can be made. Let's get together and solve your own particular expansion problems.

Teddington Bellows are produced in technical collaboration with the Solar Aircraft Co., U.S.A.



Send for our descriptive brochure E.75

PIPES ON THE MOVE PREFER **TEDDINGTON BELLOWS**

TEDDINGTON AIRCRAFT CONTROLS LTD., INDUSTRIAL BELLOWS DIVISION, AMMANFORD, CARMARTHENSHIRE. TEL : AMMANFORD 455

MECHANICAL STOKERS—FORCED DRAUGHT FURNACES—CONVEYORS—ELEVATORS

NIAGARA ENGINEERING CO. LTD.

20 BRAZENNOSE STREET,
MANCHESTER 2
DEANSGATE 7930/7939

EARLS COURT,
LONDON, S.W.5
FROBISHER 2111/2

Fosalsil Insulating Bricks

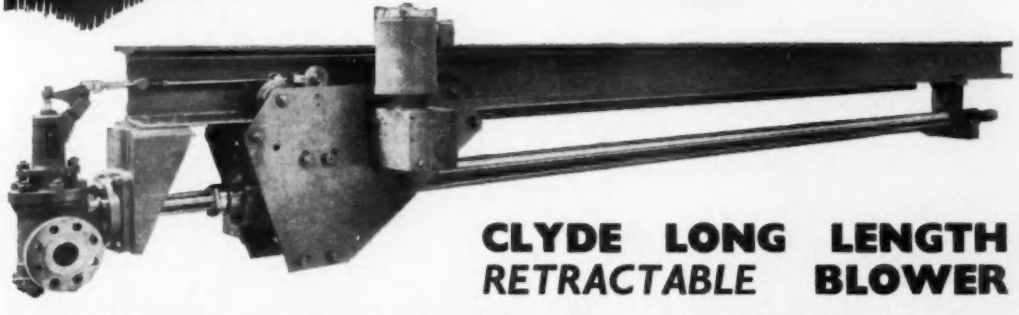
M.P. Insulating Refractories

Fosalsil Lightweight Slab Insulation

In scope and quality, an unequalled range of insulating materials

MOLER PRODUCTS LIMITED, Colchester

Clyde SOOT BLOWERS in general supply throughout the world



CLYDE LONG LENGTH *RETRACTABLE* BLOWER

This Blower is used to clean the heating surfaces where short stroke Single Nozzle Blowers, or other types, are not applicable due to the boiler design. The lance tube is projected, rotated and retracted by individual motors. Automatic push button control is provided by wall mounted starter, or by Cubicle.

By pressing the push button steam is admitted, the blower operated and stopped automatically with lance tube in the withdrawn position.

There is a Clyde Blower applicable to every type of Boiler—Land or Marine.

LONDON
34 Victoria Street. S.W.1
Phone ABBey 1847

CLYDE BLOWERS LTD
CLYDEBANK SCOTLAND
TELEPHONE: CLYDEBANK 2161/4 TELEGRAMS: "MURWILS," GLASGOW

MANCHESTER
1 Chancery Lane,
Spring Gardens, 2
Phone DEAnsgate 4262

VEE-REG GLOBE VALVES

SCREWED OR FLANGED

AVAILABLE IN BRONZE OR STEEL

• *THE* REGULATING/STOP VALVES

Designed for pressures up to 900 p.s.i. and temperatures up to 900° F, the special formation of the stainless steel clack and seat ensures perfect working under the most searching conditions.

. . . . .

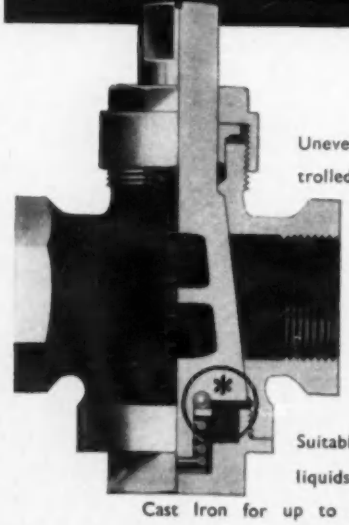
SUITABLE FOR STEAM, OIL, GAS, AIR, AND HIGH-PRESSURE HOT WATER.

. . . . .

— SOLE DISTRIBUTORS FOR THE U.K. & EIRE —

BRITISH STEAM SPECIALTIES LTD.
FLEET ST. LEICESTER.
T.N. LEICESTER
20885/6/7 & 58729.

THIS COCK DOESN'T JAM



Uneven expansion is controlled by spring-fed ball bearings which keep the plug always free in the barrel. Made in sizes ¼ in. to 6 in. with flanged or screwed ends. Suitable for steam, gases, liquids or liquors.

Cast Iron for up to 50 lb. p.s.i.
Gunmetal for up to 200 lb. p.s.i.

UNITED STATES METALLIC PACKING CO. LTD.

Soho Works, Bradford 8
Telegrams: "Metallic," Bradford
Telephone 41284-5

U.S.M.P

Branch Offices: London, Liverpool, Glasgow, Manchester, Newcastle, Cardiff, Southampton, Hull, Swansea and Bristol.

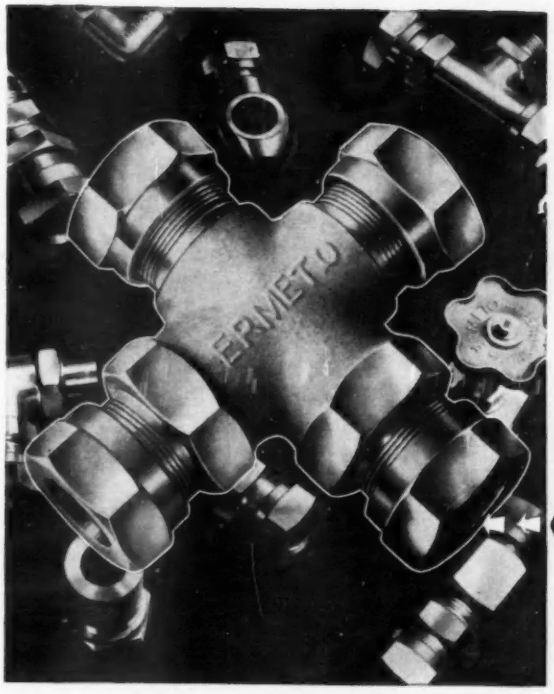
To indicate TEMPERATURE

For accuracy, ease of reading, robustness, economy and long, trouble free life install Rototherm instruments. Thermometers, Controllers and Recorders are available to suit most industrial Marine and Laboratory requirements. Specialists in bi-metallic applications. *Write for details.*

Rototherm

BI-METAL · MERCURY-IN STEEL · VAPOUR PRESSURE

THE BRITISH ROTOTHERM CO. LTD.
Merton Abbey, London, S.W.19. LIBerty 7661
Nottingham Factory: Hollis St., New Basford. Phone 77847



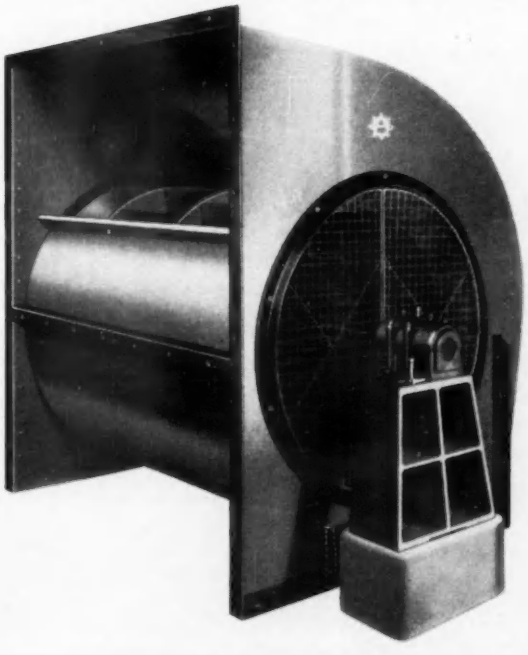
Internationally Recognised

ERMETO fittings are the internationally recognised method of coupling high pressure pipe lines. Enormous numbers are in use throughout the world. Supplied in mild steel, stainless steel, brass, bronze and aluminium for all pipe sizes, standard and non-standard up to 2" o.d.

A wide range of valves also available. Catalogues on request.

ERMETO

BRITISH ERMETO CORPORATION LTD
Beacon Works, Hargrave Road, Maidenhead
Tel: Maidenhead 5103 (10 lines)



FANS

FORCED AND INDUCED DRAUGHT

EXHAUSTERS

PRIMARY AIR

SECONDARY AIR

RECIRCULATING

FANS FOR ALL OTHER PURPOSES

ALLDAYS & ONIONS LTD.

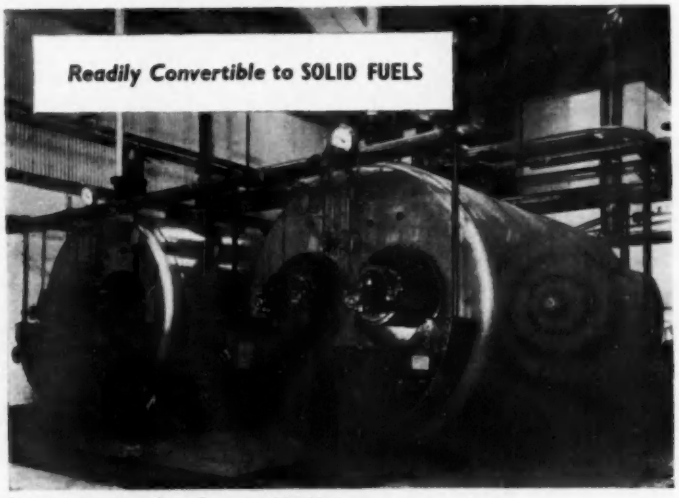
GREAT WESTERN WORKS, BIRMINGHAM, 11. TELEPHONE: VICtoria 2251-4
LONDON OFFICE: 2, QUEEN ANNE'S GATE, WESTMINSTER, S.W.1. TELEPHONE: WHitehall 1923-4-5

High efficiency cuts costs...

The Contraflo **SUPER ECONOMIC**
PATENT Nos. 429383 and 475031

DANKS OF NETHERTON LIMITED ESTABLISHED 1840

The Danks Contraflo Super-Economic self-contained boiler is designed and built for maximum reliability with minimum fuel consumption—repeated tests show a thermal efficiency of over 80 per cent., a factor of great importance in these times of high fuel prices. Simple to operate, with low maintenance costs the Super Economic is produced in a standard range of sizes and working pressures, for use with both solid and liquid fuels.



An installation of two Super Economic oil-fired boilers

DANKS OF NETHERTON LIMITED BOILERMAKERS AND ENGINEERS SINCE 1840
NETHERTON, DUDLEY, WORCS. Phone: CRADLEY HEATH 66417 (3 lines) London: BANK CHAMBERS, 329 HIGH HOLBORN, W.C.1

-for Quick Delivery of ENGINEERING SUPPLIES

HOP
8022
(25 lines)

**COCKS, VALVES, GAUGES,
PACKINGS, JOINTINGS,
BELTINGS, VEE-ROPES,
OILS, GREASES, etc.**

Write or phone—

W. H. WILLCOX & CO., LTD.
SOUTHWARK HOUSE, S.E.1

IVO

offer you these facilities

IVO Organization is the most comprehensive of its kind, and is always ready to advise, estimate and construct the following equipment in any part of the country.

★ Boiler settings of all kinds.

★ Boiler Linings to suit all makes of Oil Burners, Underfeed Stokers and Pulverized Fuel Burners.

★ Refractory brickwork repairs; weekend and night services available, large stocks of refractory material always at hand.

★ Fabricated welded steel plate work of all description, including chimneys and flues (we can provide drawings and calculations as required by L.C.C. and other Local Authorities if required), chequer plating, gantries, ladders, ducting in 14 gauge upwards, works and site welded oil storage tanks of all types and sizes.

★ Ivo Underfeed Stokers of the direct bunker to boiler and hopper type, suitable for all boilers, made in nine sizes from 200,000 B.Th.U.'s to 5,000,000 B.Th.U.'s all at highly competitive prices.

★ Coal and ash handling plant, oil and stoker fired air heaters for large scale drying installations.

Manufacturers of the world famous Ivo Draught Stabilizer with the pressure release and cleaning door.

IVO ENGINEERING & CONSTRUCTION CO. LTD. · WOOD LANE · W.12

SHEpherds Bush 4382/6 (5 lines)

UFEL

ION EXCHANGE

DEMINERALISATION OF FEED WATER FOR HIGH PRESSURE BOILERS.
BASE EXCHANGE SOFTENING.
LIME SODA SOFTENING.
BOILER WATER CONDITIONING.

UNITED FILTERS & ENGINEERING LTD
WATER TREATMENT SPECIALISTS—LONDON, S.W.15

UNIFILTER HOUSE
BURSTON RD., S.W.15
Tel: PUTney 4441

Follsain-Wycliffe

THE SPECIALIST FOUNDRY

The Specialist Foundry
with own machine shop
for
BLACKHEART MALLEABLE IRON CASTINGS
●
HEAT AND ABRASION RESISTING ALLOY CASTINGS
●
Manufacturers of
'PULMAC'
PULVERISING MILLS

FOLLSAIN-WYCLIFFE FOUNDRIES LTD.
LUTTERWORTH · Nr. RUGBY Tel. 10, 60 & 152

Simplifix pipe couplings are interchangeable

For assembling pipe line systems quickly and easily, use standardised Simplifix couplings. Made to B.S.S. 2051 Part I, their high standard of dimensional accuracy ensures that all fittings are interchangeable. They can be used on almost any kind of tubing, including those with very thin walls, and are available in the widest possible variations of standard and non-standard fittings. In brief you are most likely to find *your* requirements in the Simplifix range. Our illustrated catalogue gladly sent on request.

SIMPLIFIX

SIMPLIFIX COUPLINGS LTD., HARGRAVE ROAD, MAIDENHEAD, BERKS. TEL.: MAIDENHEAD 5100 (10 LINES)

CLASSIFIED ADVERTISEMENTS

LONDON TRANSPORT invites applications for post of Station Assistant Chemist at Generating Station. Applicants should have General Certificate of Education (Advanced Level) or have equivalent qualification, in chemistry. Previous experience in industrial laboratory essential. Preference given to candidates conversant with analysis and testing of solid and liquid fuels, waters, etc., and other chemical work associated with electrical generation.

Salary range £760-£805 per annum.

Medical examination; free travel; applications within seven days to—Staff and Welfare Officer, (F/EV 692), LONDON TRANSPORT, 55, Broadway, S.W.1.

EXCEPTIONAL OPPORTUNITY for experienced engineer as deputy to general manager of modern boiler and heavy engineering works in Calcutta. Applicants must be experienced and capable of taking complete charge of production planning and administrative duties relating to manufacture of engineering equipment which includes boilers, pressure vessels, chemical plant, sugar machinery, hydraulic sluice gates and equipment and rolling stocks. Excellent conditions and prospects including passages, provident fund, free furnished accommodation to the right person. Apply in duplicate with full details of experience and qualifications, age and salary required to—Box No. 260, ENGINEERING AND BOILER HOUSE REVIEW, 19-20, Noel Street, London, W.1.

OIL FIRING EQUIPMENT. One set of oil firing equipment by Combustions Limited suitable for two Lancashire or Economic boilers, capacity 8,000/10,000 lb. per hour, each comprising: two pumping and heating units including steam oil heater, Weir fuel oil pump, hot and cold oil filters, burners, furnace closing plates and controls.—GEORGE COHEN SONS & CO. LTD., Wood Lane, London, W.12. Tel.: Shepherds Bush 2070 and Stanningley, nr. Leeds. Tel.: Pudsey 2241.

THE BOWATER PAPER CORPORATION LIMITED, Engineering Division, Northfleet, Kent, require the services of a fully qualified Power Engineer to take up administrative and technical duties in connection with large industrial power plants. The applicant should have a thorough practical and theoretical knowledge of combustion and automatic control gear as applied to large high pressure boilers. It is essential that the applicant has had extensive operational and maintenance experience of large high pressure boilers and turbo-generating plant and experience of industrial plants would be a decided advantage. The applicant should be a Graduate in Engineering, a Corporate Member of the Institution of Mechanical Engineers or should have the Higher National Certificate in Engineering. Replies in the first instance, giving full details of technical and practical experience and salary required, should be addressed to—The Chief Engineer, THE BOWATER CORPORATION LIMITED, Engineering Division, Northfleet, Kent.

TWO ASSISTANT ENGINEERS with knowledge of boiler design and preferably with experience in the operation of boiler plants of various types and prepared to travel are required to fill vacancies which offer opportunities for future advancement. Apply—Box No. 261, ENGINEERING AND BOILER HOUSE REVIEW, 19-20, Noel Street, London, W.1.

Refractory Protective Glazes

Many years of highly technical research and experiment lie behind the success of our Refractory Glazes and Cement, Insulating Compositions, Metal Preservatives and Ceramic Materials.

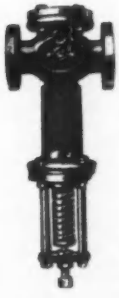
FOR THE ENGINEERING INDUSTRY

Immediate delivery. Our technicians are at your service.

Vincent Davis Glazes Limited

London Road, Stoke-on-Trent Tel: Stoke-on-Trent 44397

AULD



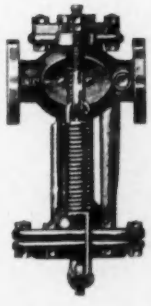
CLASS "A" TYPE

AULD'S PATENT REDUCING VALVES FOR ALL DUTIES ON STEAM, AIR OR WATER SERVICES

Also Manufacturers of :

SURPLUS VALVES, COMBINED SURPLUS AND REDUCING VALVES, FULL BORE RELIEF VALVES, STOP VALVES, DE-SUPERHEATERS, STEAM TRAPS, etc.,

FOR ALL PRESSURES AND TEMPERATURES



QUITETITE TYPE

DAVID AULD & SONS Ltd., Whitevale Foundry, GLASGOW, S.E.

TELEGRAMS : "REDUCING," GLASGOW *TELEPHONE :* BRIDGETON 2124

BURFORD, TAYLOR
AND COMPANY, LIMITED,
MIDDLESBROUGH

BOILER PLANT

We can offer you from stock:—

Water Tube Boilers

2 Lancashires 30ft. x 8ft. 6ins. x 175 lbs. w.p.

1 Lancashire 32ft. x 9ft. x 120 w.p.

1 Marine 6,000 lbs. evap. 135 lbs. w.p.

1 Cornish 1,400 lbs. evap. 190 lbs. w.p.

Also

FANS, MOTORS, PUMPS,
VALVES, PIPING, ETC.

INDEX TO ADVERTISERS

	Page
Airetool Mfg. Co. Ltd.	xxxvii
Albright & Wilson Ltd.	242, 243
Alldays & Onions Ltd.	lv
Allen, W. H., Sons, & Co. Ltd.	xxviii
Auld, David, & Sons Ltd.	lix
Babcock & Wilcox Ltd.	xlviii
Bennis Combustion Ltd.	xxxi
British Ermeto Corporation Ltd.	lv
British Paints Ltd.	xxii
British Rototherm Ltd.	liv
British Steam Specialties Ltd.	liv
Brown, J., Land Boilers Ltd.	xli
Burford Taylor & Co. Ltd.	lx
Caird & Rayner Ltd.	li
Cape Asbestos Co. Ltd.	xxx
Chesterfield Tube Co. Ltd.	xviii
Classified Advertisements	lviii
Clyde Blowers Ltd.	liii
Crane Ltd.	iv
Crosthwaite Furnaces & Scriven Machine Tools Ltd.	xxxv
Danfoss Manufacturing Co. Ltd.	Cover i
Danks, E., & Co. (Oldbury) Ltd.	xlvi
Danks of Netherton	lvi
Davey, Paxman & Co. Ltd.	xi
Dicks Asbestos Co. Ltd.	xxxiii
Evershed & Vignoles Ltd.	xvi
Fibreglass Ltd.	xiv
Flexible Shaft Mfg. Co. Ltd.	ii
Foster Wheeler Ltd.	xlv
Glenboig Union Fire Clay Co. Ltd.	xxiii
Gordon James & Co. Ltd.	li
Hargreaves (West Riding) Ltd.	xlii
Hopkinsons Ltd.	xvii
Houseman & Thompson Ltd.	xxxviii
Howden, James, & Co. Ltd.	xxi
Ivo Eng. & Construction Co. Ltd.	lvii
I.V. Pressure Controls Ltd.	xiii
Ivor Power Specialty Co. Ltd.	Back Cover
Kennedy, Allan, & Co. Ltd.	xxvi
Klinger, Richard, Ltd.	xx
Lafarge Aluminous Cement Co. Ltd.	xii, xxxiv
Midland Industries Ltd.	lx
Moler Products Ltd.	liii
Morgan Refractories Ltd.	xl
Musgrave & Co. Ltd.	x
Negretti & Zambra Ltd.	vi
Neil, J. & J., (Temple) Ltd.	xliv
Niagara Eng. Co. Ltd.	lii
Peabody Ltd.	l
Permutit Co. Ltd.	iii
Reavell & Co. Ltd.	ix
Ruston & Hornsby Ltd.	xlix
Sigmund Pumps Ltd.	xliv
Simon-Carves Ltd.	xv, xxxvi
Simplex Couplings Ltd.	lviii
Spanner Boilers Ltd.	xxv
Spirax-Sarco Ltd.	v
Starit Ltd.	xxiv
Stockton Chemical Engineers & Riley Boilers Ltd.	viii
Sturtevant Engineering Co. Ltd.	xxvii
Superheater Co. Ltd., The	lxi
Teddington Aircraft Controls Ltd.	lii
Thompson, J., Instrument Co. Ltd.	xliii
Thompson, J., (Water Tube Boilers) Ltd.	xix
Thompson, J., (Wilson Boilers) Ltd.	xliii
Turbine Furnace Co. Ltd.	vii
United Filters & Eng. Ltd.	lvii
United States Metallic Packing Co. Ltd.	liv
Unit Superheater & Pipe Co. Ltd.	x
Vincent Davis Glazes Ltd.	lix
Vokes Genspring Ltd.	l
Weir, G. & J., Ltd.	xxxix
Wicksteed, Chas., & Co. Ltd.	xxxii
Willcox, W. H., & Co. Ltd.	lvi
Woods of Colchester Ltd.	xxix

AND NOW...

1 YARROW BOILER +

MeLeSco SUPERHEATERS & REHEATERS

+ 1 YARROW BOILER

For another Central Electricity Generating Board projected power station at Blyth, Northumberland

= 550 MW

These two Yarrow Boilers, together, will supply 3,800,000 lb. of steam per hour at high temperature through MeLeSco superheaters and reheaters. This is yet another instance where our long specialised experience and unique manufacturing resources are meeting the requirements of the tremendous advance in the practice of steam generation which is now taking place.

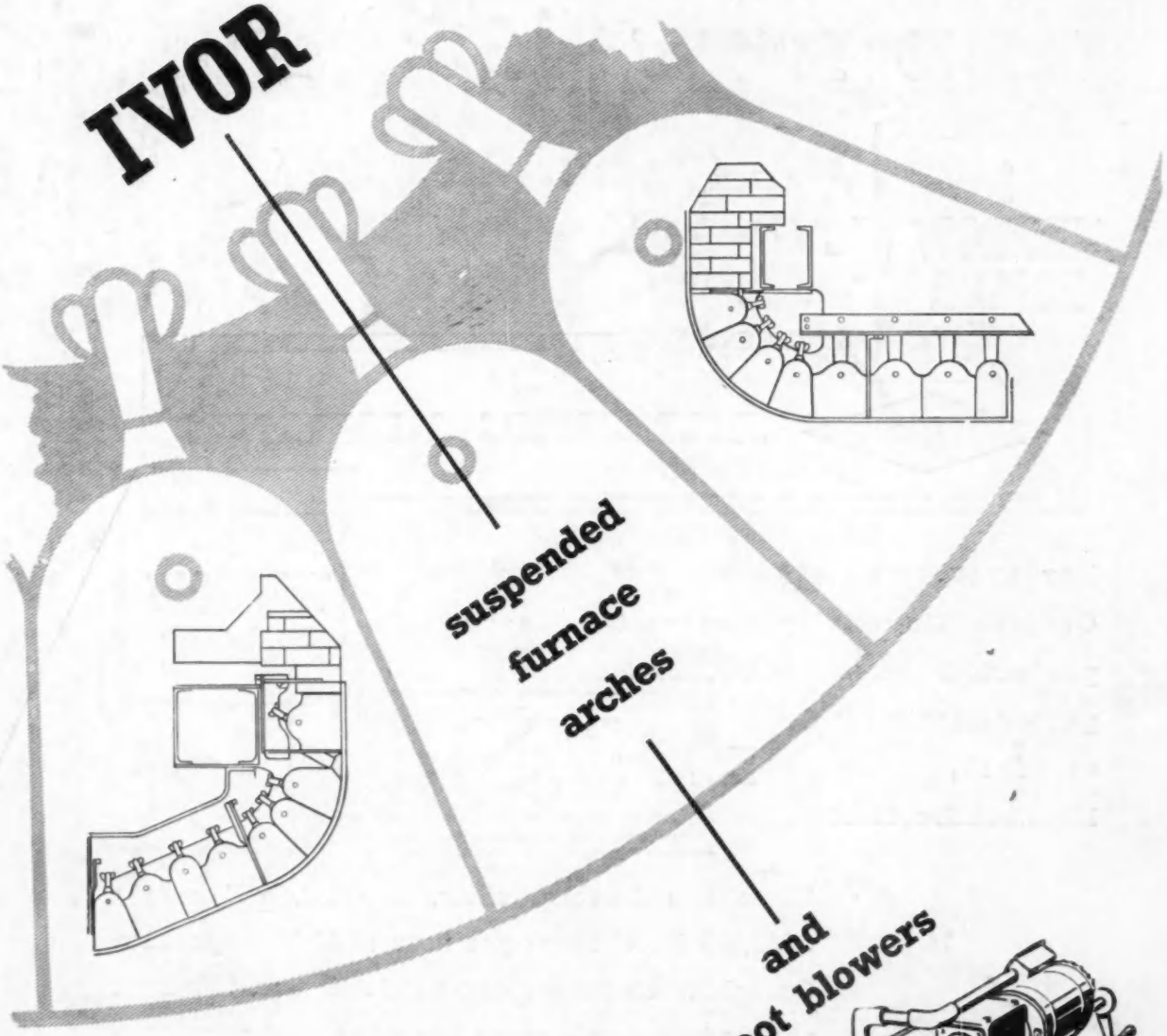
Operating conditions
Working Pressure—2,400 lb. per sq. in.
Superheat Temperature—1055° F.
Reheat Temperature—1055° F.
Temperature control by International Combustion Tilting Burners

The SUPERHEATER Company Ltd
the Authority on Superheated Steam

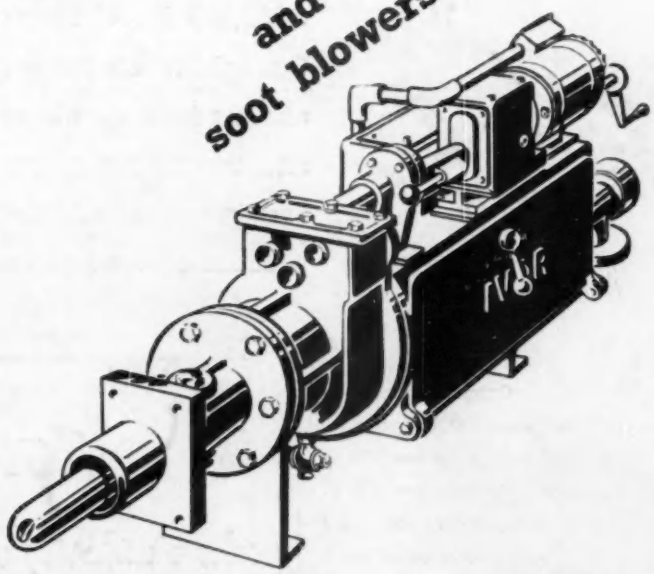
53 HAYMARKET LONDON SW1 WORKS: TRAFFORD PARK MANCHESTER 17

Broadway p23

IVOR



Two major steps
towards maximum boiler availability.
Ivor Pendulum—suspended refractory arches
permit quick renewal of defective areas
without major dismantling ;
while Ivor Sootblowers maintain
clean heating surfaces without shutdown.
Please ask us for full information.



IVOR POWER SPECIALTY CO. LTD.

29 WOBURN PLACE, LONDON, W.C.1, AND AT ABERDARE, SOUTH WALES

Broadway/ips/1

Proprietors and Publishers: Engineering Review Publishing Co. Ltd., Registered Offices, 19-20, Noel Street, London, W.1.
Printed by Electrical Press Ltd., at Cordwallis Works, Maidenhead, Berks.
Registered for transmission by Magazine Post to Canada including Newfoundland.